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FEDEX TRK #7921 7579 7150

January 27, 2003

Mr. Juan Thomas
Project Manager
United States Environmental Protection Agency
Region V (DE-9J)
77 West Jackson Street
Chicago, Illinois 60604

Subject: Replacement copies of RCRA Corrective Measures Study Field Program
Report March 2000

Dear Mr. Thomas:

Per your request BASF Corporation is submitting two replacement copies of the report entitled RCRA Corrective Measures Study Field Program Report - March 2000. Also included is a copy of the cover letter from the original submittal.

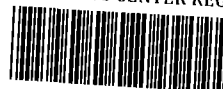
If you need additional information, please contact me at (734) 324-6298.

Sincerely yours,



Bruce Roberts
BASF Project Manager

US EPA RECORDS CENTER REGION 5



1004382

**RESPONSE TO USEPA REGION V COMMENTS ON THE
RCRA CORRECTIVE MEASURES STUDY
FIELD PROGRAM REPORT**

for the

**BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN
USEPA ID NUMBER MID 064197742**

Prepared for:

**BASF CORPORATION
1609 BIDDLE AVENUE
WYANDOTTE, MICHIGAN**

FEBRUARY 2001

Prepared by:

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PARSONS ENGINEERING SCIENCE, INC.
RESPONSE TO USEPA REGION V COMMENTS
ON THE MARCH 2000
CORRECTIVE MEASURES STUDY FIELD PROGRAM REPORT
FOR THE BASF NORTH WORKS FACILITY
WYANDOTTE MICHIGAN
FEBRUARY 16, 2001

In correspondence dated October 26, 2000, BASF received comments from the USEPA Region V on the Corrective Measures Study (CMS) Field Program Report, dated March 2000, prepared by Parsons Engineering Science, Inc. (Parsons). This response to comments submittal addresses each comment presented by the USEPA Region V in the aforementioned correspondence. Many of the USEPA Region V comments on the slug test data pertain to the use of slug-out versus slug-in tests and associated data. In response to these USEPA Region V comments on the slug test data, the reported data have been revised such that if the water table for a specific well was within the screened or sand-packed portion of the well, only slug-out test results will be used to estimate the hydraulic conductivity for that well. Note that where changes (or additions) to text, figures, or data are proposed in the response portion of this document, these changes will be carried forward and incorporated into the appropriate sections of the revised CMS Field Program Report, unless otherwise specified herein.

GENERAL COMMENTS

Response to USEPA General Comment No. 1:

This general comment addresses the scatter pattern for specific slug test well data and the duration of certain slug tests. As specified previously, if the water table for a specific well was within the screened or sand-packed portion of the well, only slug-out test results will be used to estimate the hydraulic conductivity for that well. The issues discussed in this general comment are addressed as follows:

- *Scatter of CMS-MW02 slug-in test data:* See the response to USEPA Specific Comment No. 12.
- *Short duration of CMS-MW09 and CMS-MW13F slug tests:* Parsons believes that the slug-out test data from these wells are valid. See the responses to USEPA Specific Comment Nos. 3 and 14.
- *Potentially questionable slug-in test data from CMS-MW10:* This well was re-tested in November 2000 using the slug-out method. The summary of data from the November 2000 slug re-testing program is provided in Attachment A.

Response to USEPA General Comment No. 2:

This general comment primarily relates to the use of slug-in versus slug-out testing procedures at certain wells, the general applicability/usability of the slug test data generated for certain wells, and the use of the elevation data presented in Tables 3.3 and 3.4. As specified previously, if the water table for a specific well was within the screened or sand-packed portion of the well, only slug-out test results will be used to estimate the hydraulic conductivity for that well. The issues discussed in this general comment are addressed as follows:

- The elevation data presented in Tables 3.3 and 3.4 were only used in the development of the groundwater contour maps (Figures 3.9 and 3.10).

- *For CMS-MW05:* This well was re-tested in November 2000 using the slug-out procedure. The water table in this well was above the screened interval during this re-testing program. The summary of data from the November 2000 slug re-testing program is provided in Attachment A. The raw data from the November 2000 slug re-testing program are provided in Attachment B.
- *For CMS-MW02:* Both slug-in and slug-out tests were performed in this well during the August 1999 CMS field program. Only the results of the slug-out test performed in August 1999 will be report and used in the calculation of the hydraulic conductivity for this well. The raw data from the August 1999 slug testing program are provided in Attachment C.
- *For CMS-MW07, CMS-MW08, CMS-MW10, and CMS-MW11:* These wells were re-tested in November 2000 using the slug-out procedure. The summary of data from the November 2000 slug re-testing program is provided in Attachment A. The raw data from the November 2000 slug re-testing program are provided in Attachment B.
- Parsons summarized the August 1999 data pertaining to groundwater elevations, top of sand pack elevations and top of screen elevations for the CMS and RFI wells. This information is presented in Attachment A, Table 1. In accordance with the Bouwer-Rice method, the correction for the effective casing radius should be applied, if the groundwater elevation is within the screened or sand packed portion of the well. The USEPA stated in this general comment that if the water table is within the screened or sand packed portion of the well, the slug-in test will overestimate the hydraulic conductivity, and the slug-out test is the appropriate slug testing method to use under these conditions. As specified previously, if the water table for a specific well was within the screened or sand-packed portion of the well, only slug-out test results will be used to estimate the hydraulic conductivity for that well. The following is a summary of actions taken by Parsons to address these comments:
 1. *For CMS-MW01:* The slug-out test was performed in this well in August 1999. Due to the small initial displacement in the well, this well was re-tested again in November 2000. The correction factor was applied to the effective casing radius. Refer to the response to USEPA Comment No. 13 for discussion on the usability of the slug test data from this well.
 2. *For CMS-MW02:* The slug-out test was performed in this well in August 1999. No re-testing was necessary. The August 1999 results were revised due to the application of the correction factor to the effective casing radius.
 3. *For CMS-MW03:* The slug-out test was performed in this well in August 1999. No re-testing was necessary. The August 1999 results were revised due to the application of the correction factor to the effective casing radius.
 4. *For CMS-MW05:* This well was re-tested in November 2000 using the slug-out procedure, and the correction factor applied to the effective casing radius. Note that as stated previously, the elevation data presented in Tables 3.3 and 3.4 were only used in the development of the groundwater contour maps (Figures 3.9 and 3.10). The information relevant to the slug test is shown in the data information section below the AQTESOLV graph.

5. *For CMS-MW06:* The slug-out test was performed in this well in August 1999. No re-testing was necessary. The August 1999 results were revised due to the application of the correction factor to the effective casing radius.
 6. *For CMS-MW07:* This well was re-tested in November 2000 using the slug-out procedure, and the correction factor applied to the effective casing radius.
 7. *For CMS-MW08:* This well was re-tested in November 2000 using the slug-out procedure, and the correction factor applied to the effective casing radius.
 8. *For CMS-MW10:* This well was re-tested in November 2000 using the slug-out procedure, and the correction factor applied to the effective casing radius.
 9. *For CMS-MW11:* This well was re-tested in November 2000 using the slug-out procedure, and the correction factor applied to the effective casing radius.
 10. *For CMS-MW15:* The slug-out test was performed in this well in August 1999. No re-testing was necessary. The August 1999 results were revised due to the application of the correction factor to the effective casing radius.
 11. *For RFI-MW06:* The slug-out test was performed in this well in August 1999. No re-testing was necessary. The August 1999 results were revised due to the application of the correction factor to the effective casing radius.
 12. *For RFI-MW29:* An attempt was made to re-test this well using the slug-out procedure, during the November 2000 field event. However, the slug-out test could not be performed because the well was damaged.
- The elevation data recorded during the November 2000 field event are presented in Attachment A, Table 2. A summary of the hydraulic conductivity data generated from the CMS field program (based on the data from the August 1999 and November 2000 slug testing events) is presented in Attachment A, Table 3.

Response to USEPA General Comment No. 3:

This general comment pertains to the mass flux procedure, the quality and usability of the data generated from the procedure, and the risk inferred by the mass flux data. The issues discussed in this general comment are addressed below. As stated previously, these changes will be carried forward and incorporated into the appropriate sections of the revised CMS Field Program Report.

- *The mass flux procedure and its application in inferring risk from generated field measurements:* The preliminary risk assessment performed during the RFI identified SWMU H as an area of concern. The carcinogenic risks for current maintenance workers, future maintenance, facility and construction/utility workers ranged from 6×10^{-4} to 8×10^{-3} . Closer inspection of the QST RFI risk calculations showed that the vapor inhalation of 1,2-dichloropropane (1, 2-DCP) accounted for 99 percent (%) of the total potential carcinogenic risk at SWMU H. The mass flux evaluation field

program was designed to quantitate surface emissions at the projected elevated risk level generated from the QST risk assessment (i.e., above 1×10^{-4}) and at the low end risk level (i.e., 1×10^{-6}). The high end of the risk level corresponds to a flux chamber detection of approximately 40 part per billion by volume (ppbv) in the sampled gas stream, based on a 2 liter per minute (L/min) sweep rate. If the risk level was as low as 1×10^{-6} , the flux chamber detection would correspond to approximately 0.4 ppbv in the sampled gas stream, based on a 2 L/min sweep rate.

The analytical results generated from the laboratory testing showed non-detects for 1, 2-DCP. The finding of non-detects for 1, 2-DCP, based on a 2 L/min sweep rate, demonstrated by ratio, risks for the SWMU H area in the 1×10^{-6} range. There is some uncertainty in the quantitation of the sweep air flow rate values used in the calculation of the flux rate. Based on Parsons technical evaluation of the measured flow rate values and the observed flow rates noted during the mass flux field program, it is our estimation that the maximum error ranges between $\pm 25\%$; however, no systematic bias was created by this uncertainty factor.

- *Data quality related to holding time exceedances:* All data were validated by Environmental Standards, Inc. (ESI) located in Valley Forge, Pennsylvania. ESI stated in their report that three investigative air samples generated from the mass flux program (BASF 1-2, BASF 2-2, and BASF 3-2) were analyzed three days beyond the 14-day holding time. These three samples represent one of the three sample rounds from each of the three sample locations. Air samples collected from each sample location during the remaining two sample rounds were analyzed within holding time. While the samples that exceeded holding times have been "J" flagged (where applicable) to indicate that the data are estimated, these data are typically considered usable for the purposes they are being applied in the CMS field report. Furthermore, a comparison of the detections/concentrations between the three rounds of data from each sample location does not show any trends that would suggest that the exceedance of holding times significantly impacted the concentration of analytes detected in these air samples. Summa[®] canisters were used to collect and house the sampled air prior to laboratory analyses. The Summa[®] canisters were constructed of stainless steel and the air sample within was contained under a vacuum seal. These features significantly minimize potential sample concentration losses due to air escaping through seals over time and/or due to oxidation due to exposure to ultraviolet rays, etc. Hence, this form of sample container typically maintains a greater degree of sample integrity over time, when compared with glass containers or Tedlar bags, further minimizing the potential impact of the holding time exceedances on the generated sample data. It is to be noted that the approach taken by ESI in determining which percentage of samples to validate (and to what extent) was in accordance with the validation requirements previously agreed upon between USEPA Region V and BASF, for the RFI data.

USEPA has intimated in their comments that the four orders of magnitude discrepancy between the results of the QST risk assessment and the CMS mass flux evaluation suggests an inherent problem with the mass flux data. However, if one looks at the basis for the RFI risk assessment-generated risk levels, it is obvious that QST took a very conservative approach in allowing one elevated value from a soil sample collected from a soil core situated at one location, to drive the risk for an entire area. The elevated concentration of 50,000,000 ug/kg of 1, 2-DCP, detected in a soil sample collected at location SP09A, from a depth of 15 to 16 feet below ground surface (bgs) (i.e., in the saturated zone), is three orders of magnitude greater than the next highest detected value of 140,000 ug/kg of 1, 2-DCP. This soil sample was taken from sample location SP03A, at a depth of 16 to 17

feet-bgs. Parsons believes that the data generated from the CMS mass flux field program more closely represents site conditions than the overly conservative assumptions used by QST in the RFI risk assessment; hence the great difference in the calculated risk values.

Parsons has taken the mass flux data and assessed the risk for the SWMU H area by processing the data through the risk assessment algorithms used by QST in the development of the RFI risk assessment for the SWMU H area. Since 1, 2-DCP was not detected during the mass flux evaluation, to be consistent with the QST RFI risk assessment process approach, for this risk evaluation Parsons used half of the detection limit and the 95% upper confident limit (UCL) for the 1,2-DCP data collected from the mass flux evaluation program to derive the estimate for the risk. A summary of this risk evaluation process, and the risk data generated from the effort, is presented in Attachment D.

- *Choice of flux chamber sample locations:* See the response to USEPA Specific Comment No. 4.
- *Issues related to the use of tap water; impact of ambient air temperature; and the proximity in time of the last rain fall on the mass flux sampling program:* See the response to USEPA Specific Comment No. 5.
- *Issues related to the time of day that the mass flux field program was executed:* See the response to USEPA Specific Comment No. 6.

Response to USEPA General Comment No. 4:

This general comment pertains to the development of a Site Conceptual Model. BASF has developed a conceptual model for the site. This model and the associated discussion are also presented in Attachment D.

SPECIFIC COMMENTS

Section 2.3.2, Soil Borings/Monitoring Well Installation. ***USEPA Comment No 1:***

Section 2.3.2 of the CMS Field Report presents information regarding the installation of the monitoring wells installed during the CMS Field Program. With respect to the installation of the monitoring wells installed in the fill unit, the CMS Field Report states "The top of the screened section was placed above the static water level (i.e., within the saturated thickness of the fill), unless the saturated thickness of the fill exceeded 15 feet." This sentence is confusing and it apparently contradicts itself. The CMS Field Report should be revised to clarify whether the monitoring wells in the fill unit were intended to be installed with the top of the screened section above the static water level or below. Based on data presented in the CMS Field Program Report, many of the fill unit wells appear to have been installed with the top of the screened interval below the static water level under the potentiometric conditions experienced during the December 1, 1999 water level measurements.

Response to USEPA Comment No. 1:

This sentence will be reworded as follows: "The screened section of each well was placed to intercept the saturated thickness of the fill, to maximum depth of 15 feet."

Section 2.3.4, Slug Testing.

USEPA Comment No. 2 :

Section 2.3.4 states that a six-foot slug was used for the slug tests. The displacement volume of the slug is not provided. The CMS Field Program Report should be revised to provide this information.

Response to USEPA Comment No. 2:

The dimensions of the slug used in the August 1999 CMS field program slug testing are as follows: (1) length - 6 feet and (2) diameter - 1.34 inches. The volume of water displaced by this slug is approximately 0.44 gallons. It is noted that for the November 2000 slug testing program, the dedicated bailer that was left in each well (from the August 1999 CMS field program) was used as the slug, due to its accessibility. Each bailer has a length of 36 inches and an outside diameter (O.D) of 1.6 inches. The volume of water potentially displaced by the bailer is approximately 0.31 gallons. (Note: The bailer can hold approximately 0.27 gallons of water). This information will be added to Subsection 2.3.4 of the CMS Field Program Report.

Section 2.3.4, Slug Testing.

USEPA Comment No. 3:

The following text is presented in Section 2.3.4 of the CMS Field Program Report: "To avoid damaging the transducer, the stainless-steel slug was carefully introduced into the well. It took approximately 15 to 20 seconds from the beginning of the slug insertion until the slug was stabilized and the water fluctuations due to the slug insertion were dampened ("slug-in" test). In cases where the well did not recover quickly, curve fitting was performed for the data collected in the later stage of the test and, therefore, the initial water fluctuations did not have an impact on the quality of the results." The practice of "carefully" introducing a displacement slug into a well during a slug-in test is not consistent with typical slug test procedures. Generally, the volume displacement occurring for a slug test is described as "suddenly" (Bouwer and Rice, 1976) or "quickly" (Bouwer, H., 1989) rather than "carefully." Nevertheless, apparently this practice was used during the CMS Field Program due to equipment concerns and generally, other than concerns related to General Comment 2, above, the results appear to provide data suitable for analysis.

Most of the falling water level (slug-in) data plots in Appendix C do not obviously show any influence due to the "careful" insertion of the slug. For example, at monitoring well CMS-MV08 there is a steady curve for the first several minutes of the test. Thus, it appears that either the slug was coincidentally inserted into the well during the first 15 to 20 seconds at a rate that allowed the data to plot as a straight line consistent with the plot for the next several minutes or the slug was entered into the well over a much shorter time than 15 to 20 seconds. Another alternative is that the plot could have been started at time equals zero minutes ($t=0$) after the 15 to 20 second slug insertion period. Monitoring wells CMS-MW12, RFI-MW01, RFI-MW02, AND RFI-MW03 show similar patterns as CMS-MV08 in the first 15 to 20 seconds.

The "careful" insertion of the slug for the slug-in analyses would be expected to be seen in the first 15 to 20 seconds of the data plots presented in Appendix C. This affect is not apparent in the data plots presented in Appendix C. Though it does not appear that the data from the first 15 to 20 seconds of the slug tests significantly influenced the analyses, the lack of influence from the "careful" insertion appears incongruous. In the revised CMS Field Program Report that is submitted in response to these comments, the slug-in data for wells CMS-MW08, CMS-MW12, RFI-MW01, RFI-MW02, and RFI-MW03 should be reviewed for the falling water level slug test analyses and the data affected by the slug insertion should be identified. If a rapid slug insertion was used for some wells, or if the time was started ($t=0$) after the slug was in place, this should be clarified in the CMS Field Program Report.

Response to USEPA Comment No. 3:

The following is a description of the slug testing procedure Parsons used at the site. The frequency of the data recording was set using a logarithmic time scale, with a one-minute interval being the maximum interval between any two records. The recording of water level data in a well started several seconds before the slug was inserted into the well. After this initial recording period, the slug was quickly inserted in the well. (Raw slug test data from the August 1999 slug testing program are presented in Attachment C. Raw slug test data from the November 2000 slug re-testing program are presented in Attachment B.)

Water levels in the wells fluctuated erratically during the early phase of a test. These erratic fluctuations occurred during either slug insertion or removal. These data were not used in slug test analysis. The line for the slug test analysis was fitted without using these points.

In the CMS Field Program Report, Parsons intended to state that, in general, water levels in a well stabilized (i.e., the erratic fluctuations leveled out) within 15 to 20 seconds *after* the test started. Parsons did not intend to say that it took 15 to 20 seconds *to insert and stabilize the slug*.

Several wells recovered within a few seconds after the start of a test (CMS-MW13F, CMS-MW09, CMS-MW04). For these wells, Parsons used the slug-out results as the correct results

The collection of water level data prior to the start of a test allowed Parsons to monitor how the water level in the well approached the initial level over time. The AQTESOLV program does not allow for this initial displacement jump. For this reason, the initial water level data and the erratic water level fluctuations data was not part of the data set processed using AQTESOLV. This is the reason why it appears that the slug tests were performed in wells CMS-MW09 and CMS-MW13F for only a few seconds.

**Section 2.3.5.2, Implemented Mass Flux Field Sampling Program.
USEPA Comment No. 4:**

Text in Section 3.2.5.2 states that "Sample locations were chosen based on prior analysis of subsurface materials at SWMU H." There is no information presented in the CMS Field Program Report which specifically relates the flux chamber sampling locations with known areas of the highest volatile organic compound (VOC) contamination as determined during the RCRA Field Investigation. To better allow a determination of the usefulness of the flux chamber data, the CMS Field Program Report should be revised to provide information relating the placement of the flux chamber during the CMS Field Program to contaminant concentrations in the subsurface.

Response to USEPA Comment No. 4:

The sampling locations used in the mass flux field program were selected to coincide with approximated soil boring locations identified in the RFI, from where subsurface soil samples that exhibited high to low concentrations of 1, 2-DCP were collected. As mentioned previously in Parsons response to USEPA General Comment No. 3, soil samples collected from the subsurface at locations SP09A and SP03A exhibited the two highest detected concentrations of 1, 2-DCP during the RFI. As such, CMS mass flux location #1 was situated as near as possible to sample location SP09A (from which the 50,000,000 ug/kg 1, 2-DCP subsurface soil sample was collected). CMS mass flux location # 3 (and area replicate location #4) was situated as near as possible to sample location SP03A (from which the 140,000 ug/kg 1, 2-DCP subsurface soil sample was collected). These locations (#1, #3, and #4) were chosen to provide a reasonable estimation of air concentrations relative to the 'hot spots' identified in the RFI as the risk drivers. The CMS mass flux location # 2 (referred to as SP05C) was approximately halfway between locations #1 and #3. Subsurface soil samples from this location had exhibited a relatively low concentration of 1, 2-DCP (8 ug/kg) during the RFI. This is the reason why this location was chosen. Refer to Attachment E for a copy of Figure 7-20, excerpted from the QST RFI Report. This figure shows the locations of SP09A, SP03A, and SP05C within SWMU H. The information presented in this response is only provided for information purposes in response to the USEPA Region V comment.

**Section 2.3.5.2, Implemented Mass Flux Field Sampling Program.
USEPA Comment No. 5:**

Section 2.3.5.2 of the CMS Field Program Report describes the use of tap water as a simple sealant around the collar of the flux chamber to minimize the amount of sweep gas able to escape the chamber under the collar. Water in soil can effectively saturate soil pore spaces as it percolates/infiltrates into the subsurface - all but precluding mobility of VOCs and their extrusion to ambient air. The necessity for the use of tap water during the flux chamber investigation should be discussed in the CMS Field Program Report, including the potential ramifications on the measured concentrations of contaminants in the flux chambers. In addition, the proximity in time of the last rain event prior to collection of flux measurements is not discussed. Even a minor rain event can effectively saturate soil. The CMS Field Program Report should be revised to discuss the impact of the use of tap water during the flux chamber investigation and any rainfall events that occurred preceding, or during, the investigation.

Response to USEPA Comment No. 5:

As described in the CMS Field Program Report, a small amount of tap water was used to seal the interface between the bottom of the flux chamber collar and the underlying soil. The technique for seating the flux chamber was to excavate a circular trench about 0.5 to 1 inch deep for placement of the collar, situate the chamber/collar in a stable manner, and repack the soil around the outside of the chamber/collar. Because of the porosity of the dry soil at the sampling locations, this process was insufficient to prevent the sweep air from escaping under the collar when a chamber pressure of approximately 0.5 inch water column (w.c.) was applied. As a result, a method to facilitate a seal was determined to be necessary. By adding a small amount of water to the outside of the filled trench around the chamber collar (while the sweep air was flowed through the chamber), an effective seal of approximately 1 inch w.c. was achieved. The slight positive pressure inside the chamber also served to prevent the water from saturating the soil under the dome but maintained the seal around the edge of the collar. The addition of water typically occurred once, at the beginning of each test. Some minor moistening of the interior soil around the outer edge of the collar was observed (due to capillary action), but the majority of the area was not even dampened, much less saturated. Furthermore, the mass flux sampling event occurred during an exceptionally hot, dry summer period. There was no rain during the sampling period and the ground

was dry at all mass flux sampling locations. As such, the high ambient temperature and lack of precipitation resulted in conditions that probably provided for maximized mobility of VOCs near the surface. It is noted that if surface moisture from prior rains or groundwater had been present, this would probably have represented more "normal" conditions and would have been entirely appropriate for mass flux sampling, since site conditions during a large portion of the year would fall more toward this "normal" category. The saturated conditions and the depth of the 1, 2-DCP-impacted soils (whose data were used in the QST risk assessment for the SWMU H area) probably has a much more significant impact on the mobility of the VOCs than the negligible quantity of water applied during the mass flux field process.

Section 2.3.5.2, Table on page 9 of 16.
USEPA Comment No. 6:

Based on the information presented in the sample program summary table in Section 2.3.5.2, it is apparent that the daily sampling times of the flux chambers were skewed toward the earlier part of the day. Michigan bounds the eastern time zone and ground temperatures are still heating up late in the day. In fact, radiant temperatures from the surface extending to the subsurface may just be beginning to exert an influence by the mid to late afternoon. Only three of the samples were collected after 3:00 in the afternoon. All other samples (9) were collected prior to this with two samples being collected at 9 a.m. As a result of typical temperature variations during the course of the day, it seems likely that the contaminant concentrations measured in the flux chamber are not conservative. The affect of the sampling times on the contaminant concentrations and flux measurements collected during the CMS Field Program should be described in the CMS Field Program Report.

Response to USEPA Comment No. 6:

This comment suggests that mass flux air sampling was schedule to occur before solar heating had a chance to increase the soil's surface temperature, thereby potentially biasing the results low. Parsons followed the approach laid out in the sampling and analysis plan that was reviewed and approved by USEPA Region V for the mass flux sampling event. There was no mention/requirement in this plan for scheduling the program during a specific time of the day. However, because any exposure within the SWMU H area would occur within a typical work day at the BASF Wyandotte facility, the majority of mass flux samples were collected over the course of a normal facility business day; which is typically between 7:00 A.M. and 3:00 P.M. Furthermore, the field sampling program was, in fact, delayed in order to facilitate sample collection during the warmest part of the year. As mentioned previously, the ambient conditions during the mass flux sampling period were exceptionally hot and dry. Mass flux samples were collected at all times of the day during the CMS field program - as early as 9:00 A.M. and as late as 4:00 P.M. There were no differences/trends noted in the analytical results based on the time of day of sample collection. As shown in the table in Section 2.3.5.2, mass flux samples were collected at each sampling location during both morning (A.M) and afternoon (P.M.) periods of the day.

It is to be noted that the temperature of solid or liquid phase material is one of the primary determining factors in the evaporation or evolution of VOCs. The source material that generated the high concentrations of 1, 2-DCP used in the SWMU H risk assessment is at 6 to 16 feet bgs, where there is minimal variation in subsurface soil temperature. The only time the surface air temperature will have a significant effect on the evolution rate, is if the source material is at the surface, which it is not in the SWMU H area.

Section 3.2.4, Slug Testing Field Data.

USEPA Comment No. 7:

It is not clear from the CMS Field Program Report whether a correction was made to the effective casing radius when the water levels were rising/falling within the screened or sand packed portion of the well. If a correction was made, the CMS Field Program Report should be revised to describe how the correction was made. If no correction was made, the CMS Field Program Report should explain why no correction was made.

Response to USEPA Comment No. 7:

Based on the USEPA comments, no slug-in test results will be reported for wells in which the water table is within the screened or sand packed portion of the well. Tables 1 and 2 in Attachment A, present the water table elevation, top of the sand pack, and the top of the screen elevation for slug tested wells. As stated previously, in accordance with the Bouwer-Rice method, the correction for the effective casing radius has been applied in all cases where the groundwater elevation was within the screened or sand packed portion of the well. Tables 1 and 2 also identify which well's slug test data had the correction factor applied to the effective casing radius. The correction factor was applied using the following equation:

$$r_e = \left((1-n)r_c^2 + nr_w^2 \right)^{1/2}$$

where n is porosity, r_c is the well casing, and r_w is a radius of the well plus sand pack thickness (i.e., the radius of the well borehole). A porosity of 30% was assumed in these calculations.

Section 3.2.5, Groundwater Screening Data/Groundwater Surface Elevations.
USEPA Comment No. 8:

Section 3.2.5 of the CMS Field Program Report states that "Specific Native Sand Unit wells were eliminated from use during the preparation of the potentiometric surface map, for various reasons." Examples of wells that are not included in the potentiometric surface map for the Native Sand Unit those wells east of the clayridge, the extraction wells, and wells PM2NC, PM2NB, RFIMW-27, and PM2NA. Some rationale for not including these wells in the potentiometric surface map is provided in the text of Section 3.2.5, including the following statement for monitoring wells PM2NC, PM2NB, RFIMW-27, and PM2NA. The text states that these wells "exhibited water surface elevations that appeared to be non-representative of true groundwater flow conditions." It seems that additional analysis and justification may be warranted for not including certain wells in the depiction of the Native Sand Unit potentiometric surface map.

The CMS Field Program Report should be revised to identify all of the extraction wells at the site and those monitoring wells that may be influenced by the extraction system, when operating. A discussion should be presented regarding the amount of time necessary for the monitoring wells in the vicinity of the extraction wells to recover from the influence of the extraction wells' pumping. Following the shut-down of extraction wells, if residual depressions exist in the potentiometric surface in the vicinity of the extraction wells, these depressions should be described and depicted in a map of the potentiometric surface. The current conceptual (i.e., leaving out selected data points) potentiometric surface map may remain in the CMS Field Program Report to illustrate general groundwater flow patterns, yet it seems inappropriate to present only a conceptual map and not a potentiometric surface map using all available data points for the laterally contiguous portions of the Native Sand Unit. Language such as that provided in Section 4.3.2 of the CMS Field Program

Report which states "The groundwater extraction system is responsible for the shallow depressions noted in the south-central area of the Facility, where the groundwater along the southern edge of the Facility is shown to be flowing north toward the extraction system" should be supported by appropriate figures which show the influence of the extraction system on the potentiometric surface.

Section 3.2.5 states that monitoring wells PM2NC, PM2NB, RFIMW-27, and PM2NA "contained groundwater surface elevations that depicted isolated lows (sinks) or highs (mounds) that detracted from the basic conceptual intent of the groundwater flow map...." If the conditions that caused these isolated lows or highs can be isolated and described (i.e., leaking water pipe, recharge area, isolated sand lens, near an extraction well), this information should be provided in the CMS Field Program Report. If, based on historic data, BASF determines that these wells are hydrogeologically isolated from the Native Sand Unit, BASF should present a discussion regarding the general representativeness of these monitoring wells and their future usefulness for describing flow in the Native Sand Unit. In addition, with respect to the groundwater monitoring wells located in the Native Sand Unit on the east side of the clay ridge, BASF could depict the potentiometric surface for these wells on Figure 3-10 as long as the figure clearly indicates the interpreted groundwater divide between the Native Sand Unit wells east of the clay ridge and those Native Sand Unit wells west of the clay ridge.

Response to USEPA Comment No. 8:

Figure 3.10 has been revised to show the extraction wells at the site. The title of the figure has been changed to reflect that the figure shows the groundwater contours for the Native Sand Unit west of the clay ridge. See Attachment G. Parson used professional technical judgment to assess which data should be used in the development of the potentiometric surface maps. No additional information, above and beyond that stated in Section 3.2.5, is available.

BASF routinely measures groundwater elevations for all wells that can be accessed at the time of sampling. The data from wells that may be partially damaged or may have questionable integrity, while not fully representative of site conditions, provides BASF with a reference base for the potential changes that have occurred when comparisons are made between data from different periods and/or years. When the data is assessed to facilitate the generation of groundwater contour maps, the rationale described in Subsection 3.2.5 is used to determine which data point(s) may or may not be representative.

BASF has no requirement nor set schedule for measuring the water elevations in all of the wells. The water elevation in the extraction wells and certain nearby piezometers are measured quarterly.

During the November/December 1999 water elevation measurements, most of the extraction wells were not in operation because the carbon was being changed. Because they were not in operation, their influence was not shown in the groundwater contour map. During the RFI, step drawdown tests were conducted on three of the extraction wells. The results are discussed in the Final RFI in Sections 7.1.2.3 through 7.1.4. Final RFI Figure 7-15 was developed to provide a representation of the groundwater contours with the extraction system in operation.

Table 3.3, Groundwater Elevations, November 1999.
USEPA Comment No. 9:

Table 3.3 presents the groundwater elevations as they were measured at the site on November 30, 1999 and December 1, 1999. These measurement dates are presented in Footnote 1, presented at the end of the table. Section 3.2.5 of the CMS Field Program Report states that all water level measurements were recorded on December 1, 1999. Either Table 3.3 or Section 3.2.5 should be revised to address this apparent discrepancy.

Upon inspection, many of the other footnotes presented at the bottom of Table 3.3 add confusion to the interpretation of the table. For example, Footnote 10 states that "RFIM2-29 may not have recovered fully, as some water was removed from the well when the bailer was withdrawn." It is not clear why RFIMW-29 was bailed prior to measuring the water level in this well. In addition, the entry in Table 3.3 for RFIMW-29 is not annotated to indicate that a footnote exists to qualify the water level for this well. The entry in Table 3.3 for monitoring wells RFIMW-29 should be annotated and an explanation should be provided in either Section 3.2.5 of the CMS Field Program Report or the footnote regarding the bailing of this well prior to measuring the water table.

Several other aspects of the footnotes for Table 3.3 are confusing. Footnote 9 states that well TW-5 heaved approximately 0.5 feet; yet survey data and water level data are presented. A similar footnote is noted for well P-7-N. It is not clear whether the data in the table are representative of pre-heave or post-heave conditions. The footnotes in Table 3.3 should be revised to specify whether the measurements presented in the table are representative of the current conditions at the site.

All of the footnotes associated with Table 3.3 should be referenced within the table to notify the reader that footnotes exist. Additional footnotes should be added to explain the use of "" and "?" symbols in the well names, even if these characters are part of the location number. Also, comments such as those presented in Footnote 7, "Extraction wells 1 through 13 were not operating during survey... Extraction wells 14 and 15 were operating when surveyed on December 1" should be discussed in greater detail in the text of the CMS Field Program Record. The time allowed for the rebound of the aquifer following the shutdown of the wells should be discussed, and the potential effect of the operation of extraction wells 14 and 15 on the potentiometric surface should be analyzed.*

Response to USEPA Comment No. 9:

Modifications have been made to Table 3.3 to enable the footnotes to be more easily identified. See the attached revised Table 3.3 presented in Attachment F. In addition, the second paragraph, first sentence of Section 3.2.5 will be corrected to read as follows... "The groundwater surface elevations were generated from the water level measurement survey that was performed during the period of November 30 and December 1, 1999."

It is to be noted that monitoring wells TW-5 and P-7-N had heaved prior to the November/December 1999 readings. The TOC for well P-7-N had been re-surveyed in August 1999 and the elevation had not changed from the previous survey. Since the TOC for well P-7-N had not changed, BASF assumed that the TOC for well TW-5 had not changed either.

**Tables 3.6, 3.7, and 3.8, Summary of Groundwater Sampling Results.
USEPA Comment No. 10:**

Tables 3.6, 3.7, and 3.8 do not contain footnotes to define abbreviated aspects of the tables. These tables should be revised to include footnotes which reference Table 3.11, Glossary of Data Qualifiers. In addition, either these tables or Table 3.11 should be revised to define the term "NA."

Response to USEPA Comment No. 10:

A footnote will be added to Tables 3.6, 3.7, and 3.8, referencing the explanation of qualifiers to Table 3.11, entitled Glossary of Data Qualifiers. "NA" has been added to Table 3.11, with an explanation that the acronym means "this constituent was not analyzed for in this sample."

**Section 3.3.1, Groundwater Analytical Data, and Section 3.3.2, Air Data.
USEPA Comment No. 11:**

The tables referred to in Sections 3.3.1 and 3.3.2 are incorrectly referenced in the text. For example, the air sampling results are referenced as occurring in Table 3.7. In fact these air sampling results are presented in Table 3.9. The text of Sections 3.3.1 and 3.3.2 should be revised to correctly reference Tables 3.6 through 3.10. Table 3.11 is not currently referenced in the text. The text should be revised to reference this table. In addition, Table 3.10 presents the flux chamber detections, which are not discussed in the text. Based on the presentation of numerous calculated fluxes, and not just that for 1,2-dichloropropane as suggested in the text, the text of Section 3.3.2 that refers to Table 3.8 does not apparently apply to Table 3.10, as would be expected if the table numbering was off by 2 (i.e., Table 3.7 should be Table 3.9). It seems that the text of Section 3.3.2 should be revised to correctly state the purpose of Table 3.10. In addition, the text should state where the results presented in Table 3.10 are discussed in the CMS Field Program Report.

Response to USEPA Comment No. 11:

All table references within Sections 3.3.1 and 3.3.2 will be checked and the text references to Tables 3.7 through 3.11 corrected as follows:

- The reference to Tables 3.4 and 3.5 in the first sentence of Section 3.3.1 will be eliminated.
- A reference to Tables 3.7 and 3.8 will be added to the first sentence of Section 3.3.1.
- The reference to Table 3.7 in the first sentence of Section 3.3.2 will be changed to Table 3.9.
- The reference to Table 3.8 in the second sentence of Section 3.3.2 will be changed to Table 3.10.
- Refer to the first bullet under the response to USEPA General Comment No. 3 for discussion related to Table 3.10. This discussion will be added to Section 4.4.
- A sentence will be added to the end of Sections 3.3.1 and 3.3.2, respectively, that states "All data qualifier information is provided in Table 3.11." As specified previously, "NA" will be added to Table 3.11, with an explanation that the acronym indicates that "this constituent was not analyzed for in this sample."

Appendix C, AQTESOLV Graphs.
USEPA Comment No. 12:

A portion of the plotted data for monitoring well CMS-MW2 appears to contain some randomly scattered data points. The scattered data points are not consistent with behavior typical of water flowing into a monitoring well. Scattered data points are also observed for other data sets such as well RFIMW-13 and RFIMW-22. If outside influences are responsible for the water level changes necessary to create the scatter pattern, these influences, and their effect on the slug test analysis should be discussed in the CMS Field Program Report. If the scattered points are the result of technical problems with the slug test analysis equipment, the problems that were experienced and their potential effects on the slug test analysis should be discussed.

Response to USEPA Comment No. 12:

In August 1999, the water table in well CMS-MW02 was within the sand packed portion of the well. Based on the USEPA comments, no slug-in test data will be reported for this well. No data scatter was observed for the slug-out test. The results of this slug-out test will be used.

Parsons considers the results from wells RFI-MW13 and RFI-MW22 to be acceptable data. Based on the results of other tests, Parsons does not believe that the testing equipment was malfunctioning; otherwise, the data scatter would be observed on a more frequent basis. Parsons believes that neither the slug nor the transducer was moved during the test, since the graphs do not show a distinct step and the remaining points fit into the same straight line. In addition, both of the wells show straight lines with the same slope before and after the scatter. Given these factors, Parsons believes that the data used for analysis of these wells are acceptable.

Appendix C, AQTESOLV Graphs.
USEPA Comment No. 13:

The volume of water displaced in a slug test may be estimated from plotted slug test data by reading the displacement when the time is zero ($t=0$). For monitoring well CMS-MW1, the total displacement from static water level was slightly more than one inch. This displacement does not seem significant enough to yield representative results from a slug test analysis. The BASF Corporation should review the slug test results for monitoring well CMS-MW1. The reason for such a small displacement should be discussed in the CMS Field Program Report and the possibility that the slug test results are not representative should be assessed by a qualified hydrogeologist. If the results of the slug test analysis for this well are deemed to not be representative, the results should be identified as such in the CMS Field Program Report. It may be helpful to repeat this test to achieve a more significant initial displacement.

Response to USEPA Comment No. 13:

In August 1999, the height of water column in well CMS-MW1 was 1.64 feet. The transducer is approximately 1.2 feet long. Even though the transducer was lowered almost to the bottom of the well, the available depth of water for displacement is approximately 0.4 feet. The well was re-tested in November 2000 and the water table elevation only had a 0.01-foot differential from that measured in August 1999. The new (November 2000) test results are similar to the previously obtained results (from August 1999). This test may not be representative of hydrogeologic conditions at the site and it will not be used for further analysis.

**Appendix C, AQTESOLV Graphs.
USEPA Comment No. 14:**

Section 3.2.4 of the CMS Field Program Report states that the slug test results from monitoring well CMS-MW4 were not used because the well "recovered within 10 seconds of the start of both (slug-in and slug-out) tests." This statement implies that there may be limitations to either the equipment or the standard operating procedures (SOP) used for the slug tests that make the results from the first 10 seconds unreliable or difficult to interpret. The slug test data plots for monitoring wells CMS-MW09 and CMS-MW13F are presented for time periods of approximately 3 seconds. The slug test data plots for wells CMS-MW15 and CMS-MW18 are presented for only 15 or 20 seconds of the recovery time. If there is a reason that the data from monitoring well CMS-MW04 was not used, either related to the equipment or the SOPs, this reason should be described in more detail in the CMS Field Program Report. In addition, the three seconds worth of data presented for wells CMS-MW09 and CMS-MW13F should be reviewed by a qualified hydrogeologist to determine if the data are acceptable. If there are equipment limitations or limitations related to the slug test method that limit the usefulness of the data collected in the first 10 seconds, the slug test results from wells CMS-MW15 and CMS-MW18 should be reviewed to be sure they are acceptable. If necessary, recalculated slug test results should be appropriately incorporated into the discussion, tables, and figures in the CMS Field Program Report.

Response to USEPA Comment No. 14:

Well CMS-MW04 recovered within a few seconds during both slug-in and slug-out tests. The raw data collected during these tests are included in Attachment C. Since the water table is above the sand packed portion of the well, Parsons believes that such a quick recovery is not due to the sand pack, but due to the permeability of formation. The data from this well was not used because in Parsons' technical judgment it exhibited significant randomness.

Wells CMS-MW13F and CMS-MW09 also recovered within seconds during both slug-in and slug-out tests; however, a curve could be fitted through the limited number of data points. The water table is above the sand packed portion of the well, and Parsons believes that this quick recovery is due to the permeability of formation. Parsons acknowledges the limitations associated with using slug tests to assess very permeable aquifers, and the limitations associated with fitting the slug test data to a straight line based on only a few data points. Parsons will acknowledge the limitations of the slug tests results for these wells in the CMS Field Report. As indicated previously, the additional technical information, revised graphs, and the raw data presented herein will be added to the revised CMS Field Program Report.

Similarly, Parsons believes that the subsurface material in the vicinity of CMS-MW15 and CMS-MW18 is very permeable. The presented results are the best estimates for hydraulic conductivity that can be obtained from slug testing these wells.

**RCRA CORRECTIVE MEASURES STUDY
WORK PLAN**

for the

**BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN
USEPA ID NUMBER MID 064197742**

Prepared for:

**BASF CORPORATION
1609 BIDDLE AVENUE
WYANDOTTE, MICHIGAN**

NOVEMBER 2001

Prepared by:

**PARSONS ENGINEERING SCIENCE, INC.
999 OAKMONT PLAZA DRIVE, SUITE 420
WESTMONT, ILLINOIS 60559**

Parsons ES Project No. 733893



K. Edward Nuernberg
General Manager
Wyandotte Site

Sent via Federal Express

November 29, 2001

Ms. Jacqueline Fisher
Project Manager
United States Environmental Protection Agency
Region V (DE-9J)
77 West Jackson Street
Chicago, Illinois 60604

RE: Transmittal of Final CMS Work Plan
RCRA Corrective Action
BASF Corporation, Wyandotte, Michigan

Dear Ms. Fisher:

BASF Corporation is transmitting three copies of the "RCRA Corrective Measures Study Work Plan" for the Wyandotte site. This work plan is a replacement for the one submitted in March of this year. The work plan was prepared on behalf of BASF Corporation by Parsons Engineering Science, Inc., the CMS consultant.

Based upon recent telephone conversations between you and BASF's Mr. Roberts, BASF has concluded that the March CMS Work Plan would not be approved, as submitted, by U. S. EPA. Please consider this work plan as a replacement for the March CMS Work Plan.

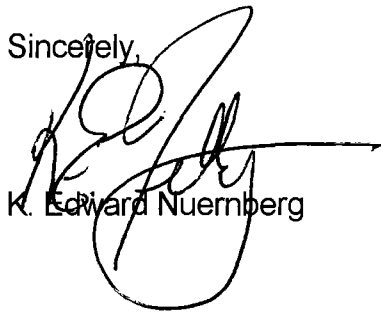
Task VII B. in Attachment III of the Order on consent states that the "respondent, in conjunction with the U. S. EPA, shall establish site specific objectives for the corrective action needed to protect human health and the environment." BASF believes very strongly that it is more efficient for both BASF and EPA to discuss the objectives before the Draft CMS Report is submitted to EPA rather than waiting until after the draft report has been submitted. Since you have stated that you will give BASF feedback on proposed objectives prior to submitting the report, BASF will be contacting you after you return from maternity leave to begin discussions on our proposed objectives.

I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to evaluate the information submitted. I certify that the information contained in or accompanying this submittal is true, accurate, and complete. As to those identified portion(s) of this submittal for which I cannot personally verify the accuracy, I certify that this submittal and all attachments were prepared in accordance with procedures designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those directly responsible for gathering the information, or the immediate supervisor of such person(s), the information submitted is, to the best of my knowledge and

belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Should you need additional information, please contact Mr. Bruce Roberts (734-324-6298) at your convenience.

Sincerely,

A handwritten signature in black ink, appearing to read 'K. Nuernberg', with a long horizontal stroke extending to the right.

K. Edward Nuernberg

Enclosures

cc: BRoberts - BASF
MSutherland - Parsons ES (letter only)
PMartin - WHI
RBlayer - MDEQ Lansing (letter only)
LAubuchon - MDEQ Livonia (letter only)
BVens - MDEQ Livonia (letter only)
BWallace - Bacon Memorial Public Library

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SECTION 1 INTRODUCTION

1.1 OVERVIEW

On February 24, 1994, BASF Corporation (BASF) entered into an Administrative Order on Consent (Consent Order) with the United States Environmental Protection Agency (USEPA) Region V for the BASF North Works Facility (the Facility) located at 1609 Biddle Avenue in Wyandotte, Michigan. The mutual objectives agreed to by BASF and USEPA Region V, as part of the Consent Order, included the following:

1. Continue to take measures to prevent the flow of contaminated groundwater from the Facility to the Detroit River.
2. Perform a RCRA Facility Investigation (RFI) to determine the nature and extent of releases of hazardous wastes and hazardous constituents at or from the Facility.
3. Perform a Corrective Measures Study (CMS) to identify and evaluate alternatives for potential corrective actions.

The RFI was performed by QST Environmental, and the Draft RFI report was submitted to the USEPA Region V in December 1997. The Final RFI Report was submitted to the USEPA Region V in March 1999. In June 1998, BASF contracted Parsons Engineering Science, Inc. (Parsons) to perform the tasks associated with the CMS. Per the Consent Order, the CMS tasks include the preparation of a CMS Work Plan and the identification and evaluation of alternatives for corrective action.

Following Parsons' review of the RFI findings and conclusions, it was concluded by both Parsons and BASF that there were existing data gaps that needed to be filled before Parsons could perform the CMS as stipulated in the Consent Order, and assess groundwater containment strategies for the Facility, especially relative to the Detroit River. As such, a CMS field program was designed to provide hydrogeological information useful in the evaluation of pump-and-treat technologies and/or containment strategies related to preventing the off-site migration of Facility groundwater into the Detroit River or to adjacent properties.

A CMS Work Plan (dated October 1998) that addressed the CMS Field Program was prepared by Parsons and submitted by BASF to the USEPA Region V. In the October 1998 CMS Work Plan, the need for additional information was discussed and the rationale and details of the CMS field program activities were presented. The October 1998 CMS Work Plan entitled, *Draft RCRA Corrective Measures Study Work Plan*, was approved by USEPA Region V in November 1998. The field work was completed and a report entitled *RCRA Corrective Measures Study Field Program Report*, dated March 2000, was submitted to USEPA Region V on March 20, 2000.

The USEPA Region V conducted an extensive review of the March 2000 report and submitted comments to BASF in a letter dated October 26, 2000. A meeting with representatives from USEPA Region V, BASF, and Parsons was held at the Facility on November 16, 2000. BASF submitted a response to USEPA Region V's comments on February 21, 2001. BASF received a letter from USEPA Region V dated November 1, 2001, stating that the report (*RCRA Corrective Measures Study Field Program Report*) is sufficiently complete.

BASF determined it would be beneficial to have a calibrated groundwater model developed for the Facility to support the CMS process. The model would be used to better understand groundwater flow at the Facility and to help evaluate corrective action alternatives. The modeling process would be performed in stages. Feedback from the USEPA Region V, on the model, will be sought at key stages in the modeling process. A more detailed description of the steps involved in the development and use of the calibrated groundwater model is provided in Appendix A.

1.2 WORK PLAN ORGANIZATION

This CMS Work Plan contains two sections and one appendix. Section 1 presents this introduction. Section 2 presents a description of the content of the CMS tasks and content requirements for the CMS Report, as specified in the Consent Order, Attachment III. This section also provides discussion on when the various CMS deliverables will be submitted to the USEPA Region V. Appendix A presents a more detailed breakdown of the groundwater modeling process.

SECTION 2

CORRECTIVE MEASURES STUDY WORK PLAN AND REPORT TASKS

2.1 OVERVIEW

The preparation of a CMS Work Plan was stipulated in the Consent Order, and the scope of work for the work plan is delineated in Attachment III to the Consent Order. This scope of work specifies that the CMS Work Plan shall consist of the following tasks:

- Task VII - Identification and Development of the Corrective Measures Alternatives
 - A. Description of Current Conditions
 - B. Establishment of Corrective Action Objectives
 - C. Screening of Corrective Measures Technologies
 - D. Identification of Corrective Measures Alternatives
- Task VIII - Necessary Laboratory and Bench-Scale Studies
- Task IX - Evaluation of the Corrective Measures Alternatives
 - A. Technical/Environmental/Human Health/Institutional
 - B. Cost Estimates
- Task X - Justification and Recommendation of the Corrective Measures
 - A. Technical
 - B. Environmental
 - C. Human Health
- Task XI - Reports
 - A. Progress
 - B. Draft
 - C. Final

The Draft and Final CMS Reports will include the information specified in Tasks VII, VIII, IX, and X.

2.2 TASK VII - IDENTIFICATION AND DEVELOPMENT OF CORRECTIVE MEASURES ALTERNATIVES

2.2.1 Subtask A - Description of Current Conditions

The Current Conditions Report was originally developed by Woodward-Clyde Consultants in 1995. Parsons has updated the Current Conditions Report to incorporate the activities and findings of recent Facility investigations such as the *Toluene Remediation Investigation Report (TRIP)*, dated December 1996, prepared by Fluor Daniel GTI, Inc., and the *Draft RFI Report*, dated December 1997, prepared by QST Environmental. The updated Current Conditions Report was prepared by Parsons in October 1998 and has been submitted as a stand-alone document.

The CMS Report will contain an update to the information describing the current conditions at the Facility and the known nature and extent of the contamination, as documented by the RFI Report. It will provide USEPA Region V with an update to the information presented in Task I of the RFI, regarding previous response activities and any interim measures (IM) that have been implemented at the Facility, if there have been any. It will also include a facility-specific statement of the purpose for the response, based on the results of the RFI. The statement of purpose will identify the actual or potential exposure pathways that will be addressed by corrective measures.

2.2.2 Subtask B - Establishment of Corrective Action Objectives

The Consent Order specifies that site-specific objectives for corrective action shall be established by BASF, in conjunction with USEPA Region V. The corrective action objectives that have been developed by BASF will be discussed with USEPA Region V prior to the submittal of the Draft CMS Report. The selection of appropriate media cleanup standards for corrective action(s) will also be included in this subtask.

2.2.3 Subtask C - Screening of Corrective Measures Technologies

A report entitled *RCRA Facility Investigation Pre-Investigation Evaluation of the Corrective Measures*, dated March 1995, was prepared by Woodward-Clyde. As part of this subtask, Parsons will review the results of the RFI, TRIP, and CMS field programs to determine whether additional technologies are potentially applicable to the Facility CMS. The preliminary corrective measure technologies evaluated in the abovementioned Woodward-Clyde report will also be rescreened by Parsons, to determine whether the additional information generated from the CMS investigation changes the determinations made during the preliminary corrective measure technologies screening. The screening process will focus on eliminating those technologies which have limitations based on inherent technological, waste, and/or site-specific characteristics. The technologies that are eliminated and the reason(s) for their elimination will also be presented as part of this subtask.

2.2.4 Subtask D - Identification of the Corrective Measures Alternatives

The activities associated with the execution of this subtask will follow directly from the conclusions/findings of Subtask C, Screening of Corrective Measures Technologies. Those technologies that survive the screening process in Subtask C will be further developed based on the corrective action objectives. The alternatives that are developed as part of this task will be (to the extent practicable from an engineering standpoint) a combination of those technologies deemed potentially applicable during the previous subtask. Multiple alternatives may be developed as deemed appropriate to the goal of addressing the corrective action objective(s). In some instances, an individual technology could comprise a single corrective measures alternative.

Given the complexity of the Facility's geology and hydrogeology, it is considered probable that the alternatives that are developed to address corrective action objectives will have to be designed to address area/location-specific physical/chemical characteristics. As such, a combination of corrective measure alternatives (versus one site wide alternative) may eventually be required to address the corrective action objectives developed for the Facility

during Subtask B. The calibrated groundwater model will be used, as appropriate, to help identify corrective measure alternatives.

2.3 TASK VIII - NECESSARY LABORATORY AND BENCH-SCALE STUDIES

BASF contracted with a consulting firm (Harding Lawson Associates [HLA]) to develop and execute a bench scale study to assess potential corrective measure alternatives associated with the reclamation of AOC 4 for future use by BASF. BASF submitted a report to USEPA Region V in August 1999, entitled *Treatability and Bench Scale Testing Report for the North Tar Pit*, prepared by HLA, which presented the finding of the bench study for AOC 4. For the CMS Report, this subtask will include a Summary Report that summarizes the HLA testing program and its results, both positive and negative.

2.4 TASK IX - EVALUATION OF THE CORRECTIVE MEASURES ALTERNATIVES

Each component of each alternative that is deemed potentially applicable based on the Task VII, Subtask D screening/evaluation process, will be evaluated based on four primary criteria:

1. Technical Concerns; i.e., the performance, reliability, implementability, and safety of the alternative.
2. Environmental Concerns; i.e., the short- and long-term beneficial and adverse effects the alternative may have on the environment.
3. Human Health Concerns; i.e., the extent to which the alternative mitigates short- and long-term potential human exposure to residual contamination and protects human health during and after the implementation of the corrective measure.
4. Institutional Concerns; i.e., the regulatory and institutional needs for an alternative and how the various regulatory standards, guidance, advisories, ordinances, or community relations requirements will impact the design, operation, and timing of the alternative.

An estimate of cost will also be developed for each corrective measures alternative that passes through the Initial Screening in Task VII. The estimate will include both capital,

operational, and maintenance costs. The level of detail in the CMS Report will be consistent with that specified in the Consent Order, Attachment III, Task IX.

2.5 TASK X - JUSTIFICATION AND RECOMMENDATION OF THE CORRECTIVE MEASURES

The execution of this task will represent the culmination of the work performed in support of the CMS. For this task, Parsons will assess each alternative based on the information generated as part of Task IX, and will further screen these alternatives based on technical, human health, environmental considerations, and cost effectiveness, as specified in the Consent Order scope of work. Summary tables will be used to facilitate the easy comparison of information between alternatives. In the final discussions associated with this task, recommendations of specific corrective measure alternatives deemed most appropriate for the Facility, will be identified based on the above-specified pertinent factors.

2.6 TASK XI - REPORTS

2.6.1 General

The reporting requirements stipulated in the scope of work for the CMS Work Plan (Consent Order, Attachment III) require the submission of (1) signed monthly reports, (2) Draft CMS Report, and (3) Final CMS Report. This section discusses the various deliverables (Consent Order stipulated and other) that are currently anticipated to be a part of the CMS Parsons will perform on behalf of BASF for the Facility. The anticipated schedule for the submittal of the additional deliverables to the USEPA Region V are also discussed below.

2.6.2 Monthly Progress Reports

BASF is currently submitting signed monthly reports to the USEPA that address all site activities being performed in support of the CMS. As allowed under the Consent Order, a separate monthly report will not be submitted specifically for addressing individual CMS tasks activities. All activities, as outlined in the Consent Order, that occur on a monthly basis

relative to the CMS will be discussed in the one monthly CMS progress report that is submitted by BASF to the USEPA Region V on or before the 10th day of each month.

2.6.3 Draft Corrective Measures Study Report

Following USEPA Region V's approval of the Final CMS Work Plan and the completion of Tasks VII through Task X, Parsons will prepare and BASF will submit the Draft CMS Report. The Draft CMS Report will, at a minimum, include (1) a description of the facility, including a site topographic map (which includes a depiction of plant communities and fish and wildlife habitat types) and preliminary layouts, and (2) a summary of the corrective measures presenting the results of the evaluation of Tasks VII through X.

A calibrated groundwater model will be used to evaluate alternatives for the CMS. Because the groundwater model will take several months to construct, BASF will submit the Draft CMS Report to USEPA Region V by September 3, 2002.

2.6.4 Final Corrective Measures Study Report

After BASF has received written comments from USEPA Region V that incorporate comments received from the public and agreement has been reached between BASF and USEPA Region V on the response to the comments, Parsons will prepare and BASF will submit the Final CMS Report. The Final CMS Report will include the incorporated comments received from the public and USEPA Region V on the Draft CMS Report.

The Final CMS Report will be submitted to USEPA Region V 60 days after BASF receives final written comments from the USEPA Region V on the Draft CMS Report and agreement has been reached between BASF and USEPA Region V on the response to the comments.

APPENDIX A GROUNDWATER MODELING

A1.1 OVERVIEW

BASF has selected Waterloo Hydrogeologic, Inc. (WHI), via a bid process, to develop a calibrated groundwater model for the Facility to support the CMS. The modeling activities being performed by WHI include (1) development of a conceptual model and report, (2) development of a groundwater model and calibration of the model to duplicate actual field conditions, and (3) modeling proposed remediation activities. These activities are explained in more detail in the sections below.

A1.2 THE CONCEPTUAL MODEL

This activity entails the development of a conceptual model for the North Works Facility and the generation a report. The conceptual model will be the basis for the development of a groundwater model for later use in the RCRA Corrective Action CMS process to simulate current conditions and to evaluate corrective measure alternatives. At a minimum, the contents of the report will be as specified in MDEQ's "Groundwater Modeling Program" document (GWCRITER.DOC) for groundwater flow models through "Model Conceptualization". When the conceptual model is completed, BASF, Parsons, and WHI will meet with USEPA Region V to obtain feedback on the conceptual model. It is expected to take three months to develop a conceptual model.

A1.3 GROUNDWATER MODEL

This activity entails (a) the development and calibration of the 3-D groundwater flow model to the existing Facility conditions, (b) performance of an uncertainty analysis, and (c) the preparation of a report for submittal to the USEPA Region V (including model development documentation). At a minimum the contents of the report will be as specified in MDEQ's "Groundwater Modeling Program" document (GWCRITER.DOC) for groundwater flow models. The calibrated model report will contain the items listed in

MDEQ's document through "Model Verification." During the development process BASF, Parsons, and WHI will meet with USEPA Region V to obtain feedback on the calibrated model. WHI will make predictions using the calibrated model, as discussed below in Section A1.4. WHI will develop and calibrate the groundwater model by April 1, 2002.

A1.4 Modeling Activities

BASF, along with Parsons, will determine what corrective measure scenarios WHI will model. WHI will make predictions using the calibrated model (based upon scenarios developed by BASF and Parsons). WHI will prepare the final modeling report for incorporation as an appendix in the CMS Report, which will be prepared by Parsons. During the development process BASF, Parsons, and WHI will meet with USEPA Region V, at the USEPA Region V's discretion, to discuss the modeling results. WHI will model the corrective measure scenarios and prepare the modeling report by June 1, 2002.

K. Edward Nuernberg
General Manager
Wyandotte Site

March 20, 2000

Ms. Jacqueline Nichele
Project Manager
United States Environmental Protection Agency
Region V, (DE-9J)
77 West Jackson Street
Chicago, Illinois 60604-3590

Subject: Transmittal of RCRA Corrective Measures Study
Field Program Report
Docket No.: V-W-011-94
BASF Corporation, Wyandotte, Michigan

Dear Ms. Nichele:

BASF Corporation transmits two copies of the RCRA Corrective Measures Study Field Program Report for the Wyandotte site. The report was prepared on behalf of BASF Corporation by Parsons Engineering Science, Inc., the CMS consultant.

The Report describes the results of the investigation at the North Work Site conducted during the Summer and Fall of 1999. As laid out in the approved work plan, this effort gathered additional information in four general categories:

- Geophysical survey using seismic refraction and electro-magnetic techniques confirmed the locations of buried drainage-ways, channels, boat slips, and the clay ridge.
- Hydrogeological tests measured the hydraulic conductivities of the Fill and Native Sand Units. These tests also confirmed there is little hydraulic connection between these two units.
- Analytical tests evaluated the general chemical make-up of the groundwater and provided insight on reactions that need to be accounted for in a treatment system.
- Measurements of the concentrations of volatile organic compounds in the soil-gas phase showed the assumptions used in the risk assessments were overly conservative.

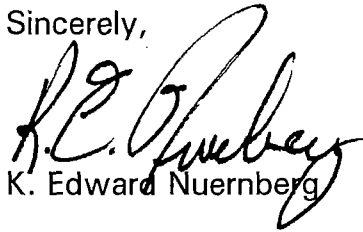
All these data and information will be used when evaluating potential corrective measures on the perimeter of the North Works property.

March 20, 2000

I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to evaluate the information submitted. I certify that the information contained in or accompanying this submittal is true, accurate, and complete. As to those identified portion(s) of this submittal for which I cannot personally verify the accuracy, I certify that this submittal and all attachments were prepared in accordance with procedures designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those directly responsible for gathering the information, or the immediate supervisor of such person(s), the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Should you need additional information, please contact Mr. Jack Lanigan (734-324-6219) at your convenience.

Sincerely,



K. Edward Nuernberg

i:\ecology\jack\cms-field-tr.doc

cc: J Lanigan - BASF
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LAubuchon - MDEQ Livonia
BVens - MDEQ Livonia
ADanford - Quanterra (letter only)
BWallace - Bacon Memorial Public Library

**RCRA CORRECTIVE MEASURES STUDY
FIELD PROGRAM REPORT**

for the

**BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN
USEPA ID NUMBER MID 064197742**

Prepared for:

**BASF CORPORATION
1609 BIDDLE AVENUE
WYANDOTTE, MICHIGAN**

March 2000

Prepared by:

**PARSONS ENGINEERING SCIENCE, INC.
1000 JORIE BOULEVARD, SUITE 250
OAK BROOK, ILLINOIS 60523**

Parsons ES Project No. 733893

CMS FIELD PROGRAM REPORT

Prepared for the
CORRECTIVE MEASURES STUDY FIELD PROGRAM
BASF CORPORATION
EPA ID No. MID 064197742

WYANDOTTE, MICHIGAN
MARCH 2000

Prepared by:
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Date

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SECTION 1 INTRODUCTION

1.1 OVERVIEW

On February 24, 1994, BASF Corporation (BASF) entered into an Administrative Order on Consent (Consent Order) with the United States Environmental Protection Agency (USEPA) Region V for the BASF North Works Facility (the Facility) located at 1609 Biddle Avenue in Wyandotte, Michigan. The mutual objectives agreed to by BASF and USEPA, as part of the Consent Order, included:

1. Continue to take measures to prevent the flow of contaminated groundwater from the Facility to the Detroit River.
2. Perform a RCRA Facility Investigation (RFI) to evaluate the nature and extent of releases of hazardous wastes and hazardous constituents at or from the Facility.
3. Perform a Corrective Measures Study (CMS) to identify and evaluate alternatives for potential corrective actions.

QST Environmental performed the RFI and submitted the Final RFI report to the USEPA Region V in March 1999. In June 1998, BASF contracted Parsons Engineering Science, Inc. (Parsons ES) to perform the tasks associated with the CMS. Per the Consent Order, the CMS tasks include the preparation of a CMS Work Plan and the identification and evaluation of alternatives for corrective action.

The findings of the RFI suggest that groundwater is the primary pathway by which chemical constituents could be leaving the Facility. As stated in the RFI report, the geologic and hydrogeologic conditions at the Facility are very complex due, in part, to natural and man-made conditions. The CMS will assess a variety of remedial and management alternatives to address the objectives of the Consent Order. However, it is anticipated that to address groundwater migration issues, groundwater containment will be a component evaluated as a portion of any corrective action strategy. After reviewing the RFI findings and conclusions, Parsons ES and BASF concluded that there were existing data gaps that needed to be filled before Parsons ES could

perform the CMS. The data gaps also impacted assessment of groundwater containment strategies for the Facility, especially relative to the Detroit River.)

(As part of the CMS, Parsons ES will also be evaluating the need for (and if deemed necessary, the extent of) corrective actions associated with mitigating the risks posed by solid waste management unit (SWMU) H (a subset location within area of concern [AOC] 5), if this SWMU is shown to pose an unacceptable risk in its current state.)

This CMS Field Program Report presents a detailed discussion of the field investigation activities Parsons ES performed as part of the CMS. The program was designed with the intent of filling the data gaps deemed pertinent to the CMS. As such, the CMS field investigation was designed to provide hydrogeological information useful in the evaluation of pump-and-treat technologies and/or containment strategies related to preventing the off-site migration of Facility groundwater into the Detroit River or to adjacent properties. Specifically, the intent of the field program was to evaluate the following key issues:

- The physical and hydrogeologic characteristics of the fill unit along the northern, southern, and eastern property boundaries.
- The hydraulic connection between the fill and Native Sand Units along the northern and southern property boundaries.
- The hydrogeologic impact of the clay ridge that runs parallel to the Detroit River shoreline along the eastern Facility boundary, relative to the easterly flow of groundwater in the Native Sand Unit.
- The chemical/physical characteristics of the groundwater in the fill and Native Sand Units along the northern and southern property boundaries, as it relates to preventing chemical constituent transport onto and/or off the Facility.)

1.2 REPORT ORGANIZATION

This CMS Field Program Report contains five sections. Section 1 presents this introduction. Section 2 provides discussion on data collection activities. Section 3 presents the data generated from the various CMS field investigation activities. Section 4 provides detailed discussion on the interpretation and implication of the data presented in Section 3. Section 5 presents a summary of

what was learnt from the CMS field program and the implications of the findings. Section 6 presents the key references used in the development of this report.

SECTION 2

CORRECTIVE MEASURES STUDY

FIELD INVESTIGATION PROGRAM

2.1 OVERVIEW AND PURPOSE

The CMS field investigation obtained hydrogeological information needed to evaluate pump-and-treat technologies and/or containment strategies that prevent the migration of groundwater from the Facility into the Detroit River or to adjacent properties. To fulfill this objective, the CMS field investigation focused on the areas where off-site migration of groundwater was most likely to occur, namely along the northern, eastern, and southern boundaries. As specified in the RFI report, the RFI groundwater investigation was focused on evaluating the Native Sand Unit. The Parsons ES CMS field investigation program focused on:

1. Assessing the physical and hydrogeologic characteristics of the shallow fill unit.
2. Understanding the role that the clay ridge performs relative to the containment of Facility groundwater flowing to the east through the Native Sand Unit.
3. Evaluating whether there is a hydraulic connection between the shallow fill unit and the Native Sand Unit in boundary areas where both units are present and separated by the peat and clay unit.

The CMS field investigation included:

- Geophysical data collection.
- Drilling of soil borings.
- Installation of monitoring wells.
- Air flux emissions assessment.
- Collection of soil samples for geologic and lithologic purposes.
- Execution of field hydrogeologic tests.

Additionally, groundwater samples were collected from selected monitoring wells and analyzed for the volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) listed in 40 CFR 264 Appendix IX. The details of the proposed CMS field program and the rationale for the various proposed activities were presented in the CMS Work Plan dated October 1998, prepared by Parsons ES, and approved by the USEPA Region V on November 20, 1998. The discussions in this section primarily (1) describe the Phase I and Phase II field activities, (2) address where the implemented Phase II field activities were modified from that which was proposed in the CMS Work Plan, and (3) present the basis for the modifications. Field procedural information has been included for specific activities, where necessary.

2.2 FIELD PROGRAM – PHASE I ACTIVITIES, EXISTING WELL ASSESSMENT

Several existing monitoring wells (installed by other consultants during previous Facility investigations) were selected to be part of the CMS groundwater sampling and aquifer testing programs. Since some of the existing Facility wells have exhibited reduced flow rates overtime due to the occurrence of geochemical interactions within the groundwater aquifer or other conditions, Parsons ES performed a preliminary well development program to assess whether the selected wells were in an acceptable condition and could be used during the aquifer pumping tests. Each selected well was developed fully during Phase I of the CMS field program, i.e., at the beginning of the field program prior to installing new wells. The following pumping rates were measured during this well development activity:

RFIMW-1	- 1.5 gpm
RFIMW-2	- 0.1 gpm
RFIMW-3	- Less than 0.1 gpm
RFIMW-4	- 0.15 gpm
RFIMW-5	- 1.0 gpm
RFIMW-6	- 1.5 gpm
RFIMW-7	- Less than 0.1 gpm
RFIMW-22	- 1.5 gpm
RFIMW-23	- 1.25 gpm
RFIMW-29	- 0.5 gpm
P-29-N	- Less than 0.1 gpm
PM4NA	- 0.1 gpm

It was proposed in the CMS Work Plan (October 1998) that the following existing wells would be used in the aquifer pumping tests: RFIMW-1, RFIMW-2, RFIMW-3, RFIMW-22, RFIMW-23, P-29-N,

and PM4NA. As shown by the above pumping rates, during well development, very little water was recovered from wells RFIMW-2, RFIMW-3, and PM4NA. Accordingly, these wells were not included in the subsequent aquifer testing program. Wells RFIMW-13 and RFIMW-14, which yielded adequate volumes of water and were located in the general vicinity of RFIMW-2 and RFIMW-3, were used instead of RFIMW-2 and RFIMW-3 during the aquifer pumping tests.

The low pumping rate at P-29-N appeared to be related to physical damage this well had sustained. Parsons installed a new well (CMSMW-15) in the vicinity of RFIMW-1 to replace P-29-N.

The low pumping rate at PM4NA was assessed to be the result of the fill formation; hence, a replacement well to facilitate aquifer pumping tests was deemed inappropriate. However, CMSMW-12 was installed at this location (into the fill) to facilitate groundwater sampling and slug testing.

Wells RFIMW-01, RFIMW-22, and RFIMW-23 were deemed acceptable for use during the CMS aquifer pumping testing field program.

2.3 FIELD PROGRAM – PHASE II ACTIVITIES

2.3.1 Geophysical Surveys

The CMS field program included the performance of geophysical surveys. Previous investigations reported the presence of former drainage ditches that transected the Facility in the northern, east-central, and southern portions of the Facility. Figures 2.1 through 2.5 of the *RCRA Facility Investigation Report of Current Conditions* prepared by Woodward-Clyde in March 1995, and updated by Parsons ES in October 1998, were reviewed to assess the approximate locations of the former drainage ditches. The geophysical survey program was designed to provide data that would facilitate a better understanding of the characteristics of the subsurface materials, and increase the potential accuracy of installing soil borings at locations where the former drainage ditch outlets and the clay ridge could be intercepted.

The suspected former drainage ditch locations were assessed using electro-magnetic (EM) techniques (both EM 31 and EM 38 techniques were performed) to provide a depth-sensitive evaluation of the locations. The depth range of EM 38 is approximately 6 feet. The EM 31 has a depth range of up to approximately 20 feet. The combined result of these two EM surveys was expected to provide adequate profiles of the former ditch areas.

Seismic refraction generally provides more data on shallow multi-layered subsurface materials. Because of the heterogeneity of the fill materials present in the subsurface at the Facility, seismic refraction was chosen as the geophysical methodology to detect the location of the clay ridge.

2.3.2 Soil Borings/Monitoring Well Installation

Parsons ES used the hollow stem auger drilling technique to advance soil borings at selected locations along the three boundary areas at the Facility. Continuous split-spoon sampling was performed throughout the entire depth of each boring. Each soil boring was converted into a groundwater monitoring well, except at the CMSSB-17 location. Depending on the boundary area being evaluated, the wells were either installed in the fill (above the peat and clay, Native Sand, and/or the lacustrine clay layers), or in the Native Sand Unit. The wells placed in the fill were installed so that the bottom of the screened section was situated at the bottom of the fill unit. The top of the screened section was placed above the static water level (i.e., within the saturated thickness of the fill), unless the saturated thickness of the fill exceeded 15 feet. The maximum screen length installed during the field program was 15 feet.

[Because the objective at certain locations was to evaluate whether there was a hydraulic connection between the fill and Native Sand aquifers, select groundwater monitoring wells installed in the north, northeast, and south boundary locations were configured into nested well pairs.] [The nested well pairs consisted of either (1) an existing RFI well in the Native Sand Unit and a newly installed CMS fill well, or (2) newly installed wells in both the fill and Native Sand Unit]

[At locations where the fill directly overlies the clay ridge, i.e., at locations where the clay ridge was not overlain by the Native Sand Unit, the objective was to evaluate the physical and hydrogeologic characteristics of the fill. As such, nested well pairs were not employed along the majority of the eastern boundary. Instead, the monitoring wells were installed through the fill such that the bottom of the well screen rested on the underlying clay ridge, facilitating the evaluation of the hydraulic conductivity of the fill.]

The location and number of soil borings (and the associated monitoring wells) was modified from what was projected in the CMS Work Plan based on the geophysical survey results, field conditions encountered during drilling activities, or the findings from the well development program. These changes included the following:

- CMSMW-2 and CMSMW-3 were relocated to form nested well pairs with RFIMW-13 and RFIMW-14, respectively, based on the findings from the CMS Phase I well development activities.
- The locations of CMSMW-9, and the CMSMW-13S/13F nested well pair were adjusted to intercept features believed to be historical drainage ditch outlet areas.
- CMSMW-14F was not installed due to insufficient fill thickness. It was deemed necessary to have approximately 3 feet of fill thickness to facilitate well installation. This fill thickness was not present at the CMSMW-14 location.
- CMSMW-15 was added to the field program to replace P-29-N, which was deemed unusable.
- CMSMW-16 and CMSMW-18 were added to the field program based on the geophysical survey results. CMSMW-16 was located in the vicinity of the northern-most former drainage ditch outlet area. CMSMW-18 was placed in the vicinity of the suspected historical drainage ditch outlet area located slightly north of the former shipping channel.
- Soil boring CMSSB-17 was added to the field program based on the geophysical survey results. It was placed in the vicinity of the suspected clay ridge/drainage ditch outlet location. It was not converted to a well because of the presence of relatively impermeable putty-like fill materials (possibly distiller blow off [DBO] materials) which were noted to be present from 2.5 to 16 feet below grade.

2.3.3 Aquifer Pumping Testing

The development and evaluation of any groundwater containment approach/alternative for the BASF facility in Wyandotte requires an understanding of the hydraulic interconnectivity between the fill and the Native Sand Units. If these units are hydraulically connected, it may be possible to control flow in the deeper Native Sand Unit by pumping water from the fill unit. Pumping tests were performed during the CMS field program to evaluate the hydraulic interconnectivity (if any) between these hydrogeological units. The nested well pairs configured during the CMS field program consisted of one well screened in the Native Sand Unit and the other well screened in the fill unit. Water was pumped from the Native Sand Unit and the associated response to this pumping was recorded in the fill unit. The

following nested well pairs (shown in Figure 2.1) were used in this hydraulic interconnectivity assessment:

- CMSMW-13F and CMSMW-13S
- RFIMW-14 and CMSMW-04
- RFIMW-13 and CMSMW-03
- RFIMW-01 and CMSMW-15
- RFIMW-22 and CMSMW-02
- RFIMW-23 and CMSMW-01

The aquifer testing program was performed in accordance with SOP-21, presented in Appendix B of the Quality Assurance Project Plan (QAPP), Addendum No. 1, February 1999. The QAPP was prepared by Parsons ES in support of the CMS field program and approved by the USEPA Region V on February 17, 1999. The procedure entailed:

1. Inserting pressure transducers into both nested wells to monitor the water level fluctuations in both units throughout the testing effort.
2. Lowering a submersible pump into the well screened in the Native Sand Unit.
3. Withdrawing water from the Native Sand well for approximately 90 minutes, at a rate calculated during the initial well development activity. (This was performed at each nested well pair.)

The water extracted during pumping was temporarily stored in a 250-gallon portable storage tank before being discharged into the on-site groundwater treatment system. Groundwater level fluctuations in the fill layer were recorded with a datalogger. It was expected that if the two stratigraphic units were hydraulically connected, the water level in the shallow well would change rapidly during pumping. Conversely, no change would be expected in the water level in the shallow well if the units were not connected.

2.3.4 Slug Testing

Parsons ES performed slug tests in 33 monitoring wells to assess the hydraulic conductivity of the subsurface throughout the Facility. The slug tests were performed in accordance with SOP-21. Testing

involved introducing a 6-foot stainless-steel slug into the screened interval of the monitoring wells and recording the change of water levels over time. A datalogger equipped with a pressure transducer was used to collect the water level readings. Parsons ES stopped collecting data when water levels recovered to within 90 percent of their original level.

The height of the water column in monitoring wells screened in the fill was, on average, between 4 and 5 feet. Prior to inserting the slug, a pressure transducer was placed close to the bottom of the well to maximize water displacement. To avoid damaging the transducer, the stainless-steel slug was carefully introduced in the well. It took approximately 15 to 20 seconds from the beginning of the slug insertion until the slug was stabilized and the water fluctuations due to the slug insertion were dampened ("slug-in" test). In cases where the well did not recover quickly, curve fitting was performed for the data collected in the later stage of the test and, therefore, the initial water fluctuations did not have an impact on the quality of results. However, if the well recovered quickly, the "slug-in" test was disregarded and the "slug-out" test was performed by removing the stainless-steel slug quickly from the well. In addition, "slug-out" tests were performed at several other locations to assess how these results compared with the "slug-in" test results. Section 3.2.4 specifies which test was performed in a particular well.

2.3.5 Mass Flux Evaluation

2.3.5.1 General Overview

The basis for deciding what corrective measures (if any) are required for SWMU H/AOC 5 is dependent on whether the SWMU H location poses an unacceptable risk to human health and the environment in its current state. The assumptions used in the risk assessment for SWMU H suggest that VOCs are being emitted from the ground surface in this area and are posing an unacceptable inhalation risk.

Parsons ES performed a mass flux evaluation (using a flux chamber) of the SWMU H area to assess VOC emission rates. Air samples were collected from the flux chamber and sent to an off-site laboratory (Quanterra, Inc.) where they were analyzed to assess the VOC concentrations. The intent was

to use these "actual condition" measurements to re-evaluate the risks posed by this area by replacing some of the broad-based assumptions with location-specific, in-field measurements.

The flux chamber measures the flux of volatile chemical constituents from a flat horizontal surface under controlled conditions. The flux chamber air sampling procedure is described in SOP 23 provided in the CMS QAPP Addendum, No. 1 (February 1999). In general terms, sampling with the flux chamber involved the following:

1. Identification of a flat surface within the area to be monitored.
2. Driving a stainless steel collar 2 to 4 inches below grade to minimize pollutant migration from surrounding areas and ambient air.
3. Attaching the flux chamber to the stainless steel collar.
4. Purging the flux chamber with diluent air.
5. Attaching the sampling manifold to the chamber outlet port.
6. Sweeping the chamber with high purity nitrogen.
7. Collecting the air samples in accordance USEPA Method TO-14, *Determination of Volatile Organic Compounds in Ambient Air Using SUMMA® Polished Canister Sampling and Gas Chromatographic Analysis*.
8. Laboratory analyses of air samples in accordance with the USEPA Method TO-14 methodologies.

SUMMA® canisters were used as the air sample collection vessels. The flux chamber was equipped with a thermocouple to measure the chamber's interior temperature, as well as a pressure gauge to monitor the chamber pressure. Sweep gas was delivered at a constant rate, and measured with a calibrated rotameter. The exhaust port of the flux chamber was equipped with a manifold, sample taps, and a bypass rotameter. The flux chamber was placed on the ground surface (at the locations shown in Figure 2.2) and allowed to equilibrate for one-half hour, before each sample was collected.

2.3.5.2 Implemented Mass Flux Field Sampling Program

The mass flux field sampling program was conducted from 12 August to 16 August 1999, during which time 13 air samples were collected from within the SWMU H area. The sampling program is summarized below:

Date	Sample ID	Type	Time
12 August 1999	BASF 1-1	Flux Sample	1037-1117
12 August 1999	BASF 2-1	Flux Sample	1500-1545
12 August 1999	BASF 3-1	Flux Sample	1230-1318
12 August 1999	BASF-Amb	Ambient Air	1610
13 August 1999	BASF 1-2	Flux Sample	1230-1320
13 August 1999	BASF 2-2	Flux Sample	1045-1135
13 August 1999	BASF 3-2	Flux Sample	0857-0947
13 August 1999	BASF Sweep	Carrier Air (Sweep Air Blank)	1325
16 August 1999	BASF 1-3	Flux Sample	1315-1405
16 August 1999	BASF 2-3	Flux Sample	1042-1132
16 August 1999	BASF 3-3	Flux Sample	0905-0955
16 August 1999	BASF 4-1	Area Replicate	1510-1600
16 August 1999	BASF -Blank	Trip Blank	1620

Three locations representative of the surface to be evaluated were selected. Sample locations were chosen based on prior analyses of subsurface materials at SWMU H. The locations were selected to represent the range of contaminant concentrations observed, without regard to depth beneath the surface. Figure 2.2 shows the locations chosen for sampling. One sample was collected from each location on each of the sampling days, with the exception of Location No. 4, which was sampled only once.

A stainless steel collar, with attached flux chamber, was placed on the surface and pushed down so at least two inches of collar was below the soil surface. Due to the gravel content of the surface fill, a small trench (2 inches deep by 4 inches wide) was dug to facilitate placement of the collar. The soil was then replaced and tap water used to prevent sweep gas from escaping under the collar. Sample and sweep air lines were attached and a thermocouple was inserted into one of the fittings using a bored-

through Swagelok™ union, and connected to the temperature readout. The pressure gauge was attached to another fitting on the dome and sweep air supplied from the cylinder at a discharge pressure of 20 pounds per square inch (psi). Pressure in the chamber did not exceed 1.2 inches water column (w.c.). A SUMMA® canister was connected to the sample tap on the sample line manifold and a bypass flow was measured with a bubble flow meter at the discharge of the manifold.

A change in sweep rate was needed due to the porosity of the surface soils, and some additional effort was required in order to effect a reasonable sweep rate. The operation of the flux chamber depends on a slight pressure inside the chamber to force the sample gas out through the sampling manifold. With the porous surface soils, a slight pressure caused the sweep air to escape through the porous fill materials. Standard operating procedure involves measurement of flow rate only in the exhaust, so the sweep air rate for the first day's samples was somewhat higher than planned (approximately 11 L/min vs. 2 L/min). As a result, the samples have a higher detection limit for the surface flux, due to the greater volume of sweep air used. However, the volume of sweep air was reduced in subsequent samples to address this issue.

Because of the soil porosity, sweep air rates needed to be high to maintain adequate bypass flow for sampling, making precise quantitation of sweep air rates impractical in some cases. The sweep air rates listed in the mass flux data results table (Table 3.8) are based on pre- and post- sampling flow measurements and the volume of sweep air used during purging and sampling. However, the possibility of different sweep rates was contemplated during program design to accommodate the objective of sampling. Based on the risk analysis values for surface flux, flux chamber analyte concentrations greater than 1 part per million (ppm) could have been observed, so a high sweep rate was needed to avoid laboratory dilution of samples to obtain quantitation. To cover the full range, samples were collected at high (12 L/min), medium (approximately 6 L/min) and low (approximately 2 L/min) sweep rates.

The chamber was purged for at least 45 minutes prior to each sample collection. A critical orifice (66 cc/min) was attached to the sample line ahead of the SUMMA® canister and vacuum gauge. The SUMMA® canister was connected to the sample tap on the sampling manifold with ¼-inch Teflon tubing. To begin sampling, the canister valve was opened and the vacuum reading recorded (it was

always 27 inches mercury (Hg) or greater). A sample volume of approximately 3 liters was desired, so the 66 cc/min orifice yielded sample times of approximately 50 minutes. Sampling was stopped when the gage vacuum had reached approximately half of the initial reading (typically 14 inches Hg). Three sample locations were sampled three times each. At each location, samples were collected on three different days. Four quality control (QC) samples were collected: a trip blank, a sweep air blank, an ambient air sample, and an area replicate (from Location 4). Canisters were analyzed by GC/MS according to USEPA Method TO-14.

2.3.6 Groundwater Field Screening and Sampling

Several common geochemical constituents in groundwater can impact the effectiveness of a groundwater extraction, injection, or treatment system. As such, it is necessary to know the concentrations of these constituents in the groundwater. Parsons ES sampled selected groundwater monitoring wells and analyzed samples for the following parameters:

- Dissolved Oxygen
- Specific Conductivity
- Temperature
- pH
- Redox Potential
- Total and Ferrous Iron

Parsons ES collected additional groundwater samples and submitted them to Quanterra, Inc. to be analyzed for the following parameters:

- Calcium
- Hardness
- Alkalinity
- Total Dissolved Solids
- Total Solids
- Total Organic Content

- Chemical Oxygen Demand

A brief discussion of the significance of each of the above parameters is presented below. An evaluation and interpretation of these data relative to groundwater treatment is presented in Section 4.2.

2.3.6.1 Dissolved Oxygen, Specific Conductivity, Temperature and pH

Readings of dissolved oxygen, specific conductivity, temperature, and pH were measured in the field when purging the groundwater monitoring wells to ensure that the water being removed from the wells was representative of the aquifer.

Dissolved oxygen measurements were also used to: (1) assess the availability of free oxygen for use in aerobic degradation of groundwater constituents, and (2) to identify if oxidizing or reducing conditions prevail in groundwater at the Facility.

2.3.6.2 Redox Potential

The redox potential is an indicator of the tendency for an aqueous solution to accept or donate electrons. The redox potential of groundwater samples was measured in the field to: (1) assess aerobic/anaerobic degradation of groundwater constituents that may be occurring naturally, and (2) to identify if oxidizing or reducing conditions prevail. Positive redox values indicate oxidizing conditions, while negative redox values indicate reducing conditions. Certain inorganic chemical species, particularly iron, sulfide, and manganese, can exist in various oxidation states depending on the redox conditions of a solution. For example, soluble ferrous iron (+2 oxidation state) will be the primary iron species present at negative redox value conditions. At positive redox value conditions, ferrous iron will oxidize, forming insoluble ferric iron (+3 oxidation state). Ferric iron tends to precipitate.

2.3.6.3 Iron

The presence of iron can create two major problems for treatment systems. One problem is the fouling of granular activated carbon (GAC) and air stripping column media, resulting in a loss of efficiency. GAC and air in the stripping column will oxidize ferrous iron into insoluble ferric iron, resulting in scale formation in either the adsorption systems or the air strippers. The reduced treatment efficiency can make a treatment system totally ineffective.

The second problem created by iron is the large concentration of suspended solids that can be created when iron reacts with other materials in solution. Iron will react with hydrogen sulfide, phosphorus, and hydroxides to produce an appreciable amount of suspended solids, resulting in additional fouling problems. Measures would have to be built into the treatment system to remove the suspended solids produced from iron, if deemed necessary.

2.3.6.4 Calcium, Hardness, Alkalinity, and Total Dissolved Solids

Another problem encountered in remediation projects is coating by calcium carbonate. This occurs when the water is supersaturated with calcium carbonate. The conditions required to produce this deposition can be evaluated from the calculation of the Langelier Index (LI). This calculation requires that the calcium, alkalinity, total dissolved solids, temperature, and pH data be measured. It is also recommended that the hardness be evaluated as a check on other values and to gain some insight into the presence of other divalent ions, e.g., magnesium. This information can then be used to assess the saturation pH (where equilibrium exists) and the LI. A LI value of zero indicates that the water is stable; negative values indicate a corrosive water; and positive values indicate supersaturation.

2.3.6.5 Total Solids

During groundwater sample collection, the presence of iron in the groundwater could result in the precipitation of solids in solution if air entrapment into the sample occurs. Measuring the total solids at the laboratory will enable a quantification of this phenomenon.

2.3.6.6 Total Organic Content and Chemical Oxygen Demand

It is highly probable that groundwater treatment at the Facility will include the enhancement of the existing GAC system. An enhanced pumping system will draw groundwater from areas Facility-wide. Although the removal of non-regulated organics is not of interest relative to this project's remedial objectives, knowing the gross organic content (total organic content and chemical oxygen demand) is important to assessing treatment efficiency and cost. GAC adsorbs a broad range of organic compounds; therefore, non-regulated compounds compete with regulated contaminants of interest for adsorption sites. This can greatly increase the carbon usage rate and may significantly reduce the

organic loading of the regulated contaminants of interest, due to competitive adsorption. As such, the non-regulated organics will influence the design of a treatment system.

Research has shown that if the influent water stream contains natural humic materials, the adsorption isotherms for certain compounds will be displaced downward indicating that competitive adsorption is occurring. The actual carbon loading was found to depend on the initial concentrations of the compounds in question. High organic content potentially has several impacts. Published isotherms generated under laboratory conditions may grossly overpredict the actual carbon loading that can be expected; therefore, the carbon usage rate may be greater. The presence of higher molecular weight, less soluble organic compounds will tend to displace the lighter weight materials, making these lighter weight compounds more difficult to remove. Natural background organics will also have this effect.

LEGEND

- EXISTING NATIVE SAND MONITORING WELL
- NEW NATIVE SAND MONITORING WELL
- EXISTING FILL MATERIAL MONITORING WELL
- NEW FILL MATERIAL MONITORING WELL
- NEW SOIL BORING

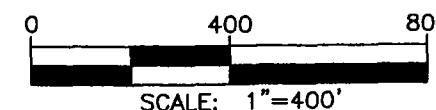
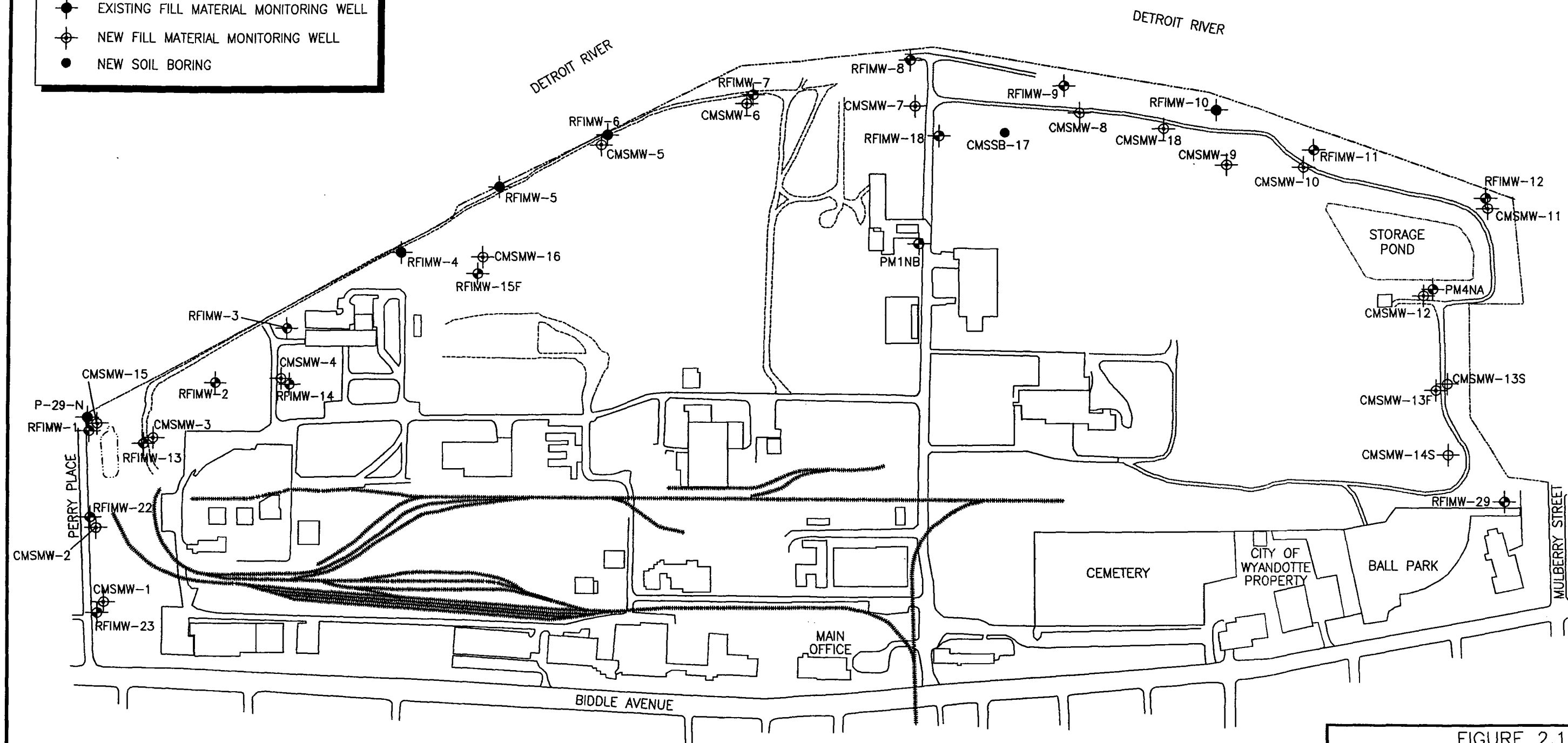


FIGURE 2.1

BASF CORPORATION
WYANDOTTE, MICHIGAN

CMS FIELD INVESTIGATION
NEW AND EXISTING GROUNDWATER
MONITORING WELL LOCATIONS

PARSONS ENGINEERING SCIENCE, INC.

DESIGN * RESEARCH * PLANNING
1000 JORIE BLVD. * OAKBROOK, ILLINOIS 60523 * 630) 990-7200

LEGEND

- ⊕ EXISTING NATIVE SAND MONITORING WELL
- ⊕ NEW NATIVE SAND MONITORING WELL
- ⊕ EXISTING FILL MATERIAL MONITORING WELL
- ⊕ NEW FILL MATERIAL MONITORING WELL
- NEW SOIL BORING
- ⊕ FLUX CHAMBER SAMPLING POINT

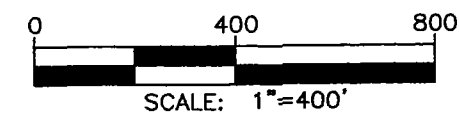
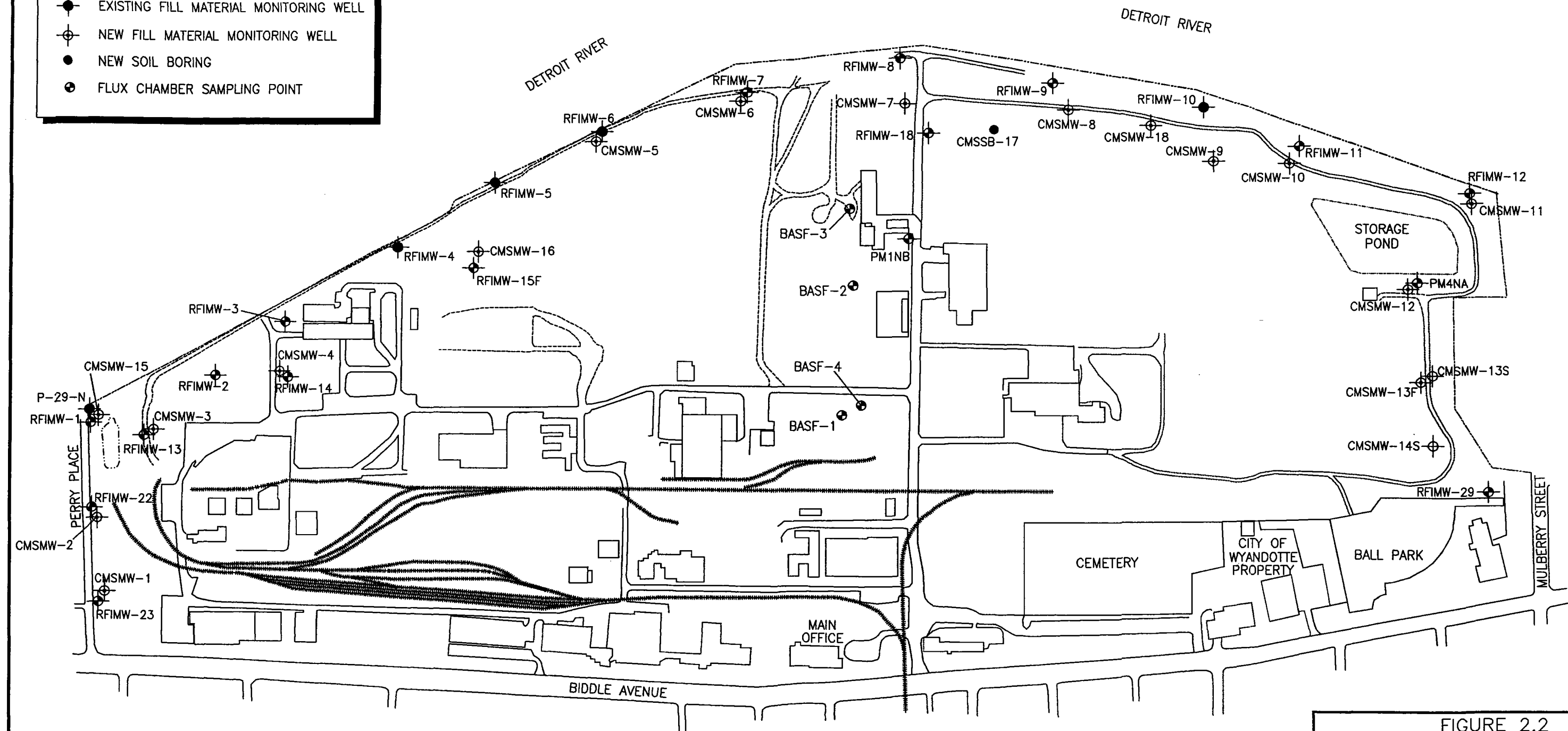
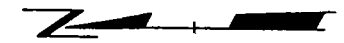


FIGURE 2.2

BASF CORPORATION
WYANDOTTE, MICHIGAN

CMS FIELD INVESTIGATION
FLUX EMISSION CHAMBER
SAMPLING LOCATIONS

PARSONS ENGINEERING SCIENCE, INC.

DESIGN * RESEARCH * PLANNING
1000 JORIE BLVD. * OAKBROOK, ILLINOIS 60523 * 630) 990-7200

SECTION 3 DATA PRESENTATION

3.1 OVERVIEW

This section presents the data that was generated from the CMS field program. The data can be classified as either field data or laboratory data. The following sections present the data associated with each of these two categories. Detailed discussion on the interpretation and assessment of the data is provided in Section 4. Note that all data tables and figures are presented at the end of this section.

3.2 FIELD DATA

The primary field data generated during the CMS field program were associated with the following activities:

- Geophysical surveys
- Soil boring
- Aquifer pumping tests
- Slug testing
- Groundwater monitoring well sampling

3.2.1 Geophysical Survey Data

Geosphere, Inc. performed the EM and seismic geophysical surveys of the Facility. The data generated from their geophysical survey activities are presented in the geophysical survey report. The complete geophysical survey report for the Facility is presented in Appendix A.

3.2.2 Soil Boring Data

During the CMS field program Parsons ES drilled and sampled 19 soil borings. Each boring was sampled continuously with a split-spoon to facilitate the lithological assessment of the subsurface materials. The primary field data generated from this activity are boring logs showing the physical description of the subsurface materials. The boring logs are presented in Appendix B. The locations of the borings are presented in Figure 2.1.

3.2.3 Aquifer Pumping Test Field Data

The results of the aquifer pumping tests (drawdown in both the Native Sand and fill wells versus time) are summarized in Figures 3.1 through 3.6. These figures show that, in general, water levels in the shallow fill layer did not respond to prolonged pumping from the deeper Native Sand Unit. The results observed at each well pair are discussed in Section 4.2.1.

3.2.4 Slug Testing Field Data

Parsons ES used AQTESOLV® software (HydroSOLVE, Inc., 1996) to plot and evaluate the results of the rising and falling head slug tests. The data were analyzed using the Bouwer and Rice (1976) method. Input files consisting of time and displacement were entered into the software program along with the appropriate radial and penetration geometry for the wells. The AQTESOLV® graphs are included in Appendix C, while the results of the slug tests for the Facility monitoring wells are summarized in Table 3.1 and Figure 3.7.

Table 3.1 lists the wells that were slug tested and the type of slug test that was performed. If both rising and falling head tests were performed on a well, the geometric mean of the hydraulic conductivity from these two tests was chosen as a representative hydraulic conductivity for the well. Since monitoring well CMSMW-04 recovered within 10 seconds of the start of both tests, the hydraulic conductivity for this well was not assessed.

3.2.5 Groundwater Screening Data/Groundwater Surface Elevations

The groundwater collected from each monitoring well that was part of the CMS field program (existing and newly installed wells) was screened for seven field parameters: pH, dissolved oxygen, conductivity, temperature, oxidation reduction potential, total iron, and ferrous iron. These data are presented in Table 3.2 and on Figure 3.8.

The groundwater surface elevations were generated from the water level measurement survey performed at each monitoring well on December 1, 1999. Table 3.3 presents a listing of the water level measurements, and Figures 3.9 and 3.10 present contour maps of the groundwater surface elevations for the fill and Native Sand Units, respectively.

The groundwater contour map depicted in Figure 3.9 was generated using the monitoring wells that were screened in fill materials only. Monitoring wells that were reportedly screened across the interface of the fill and the Native Sand Units were not used to generate of the fill unit contours shown on Figure 3.9. These wells encompass both stratigraphic units; therefore, there is uncertainty as to which stratigraphic unit is truly being represented. In addition, fill unit groundwater monitoring wells DNR-? and P-16-N were not used in the preparation of the fill unit groundwater contour map. The stratigraphic unit in which well DNR-? is screened is not defined and, therefore, was not used. Fill unit well P-16-N was not used because it is reportedly screened in DBO fill materials. This well does not reflect a true groundwater elevation because of the relatively impermeable nature of the DBO (DBO is known to be a fine grained, putty-like material). The groundwater monitoring wells used to generate the fill unit contour map are listed in Table 3.4.

The Native Sand Unit potentiometric surface map shown in Figure 3.10 was generated using monitoring wells screened entirely within the Native Sand Unit. Specific Native Sand Unit wells were eliminated from use during the preparation of the potentiometric surface map, for various reasons. The monitoring wells screened in the Native Sand Unit and located east of the clay ridge were not used because the groundwater within the interior of the Site is bounded/contained along the eastern boundary by the clay ridge and the overlying peat/clay soils. The inclusion of the wells to the east of the clay ridge would depict an inaccurate representation of the true groundwater flow direction in the Native Sand Unit as it pertains to off-site groundwater migration relative to the CMS. The wells that are part of the existing on site groundwater extraction system were also not used to construct the Native Sand Unit groundwater contour map because unrestricted flow conditions in the Native Sand Unit are needed when evaluating potential containment system alternatives associated with groundwater flow conditions.

An evaluation of the remaining Native Sand Unit monitoring wells for use in constructing the potentiometric map noted that four wells (PM2NC, PM2NB, RFIMW-27, and PM2NA) exhibited water surface elevations that appeared to be non-representative of true groundwater flow conditions. These wells contained groundwater surface elevations that depicted isolated lows (sinks) or highs (mounds) that detracted from the basic conceptual intent of the groundwater flow map, and did not

provide a significant contribution to the overall flow conditions. The groundwater monitoring wells used in construction of the Native Sand Unit potentiometric map are listed in Table 3.5.

3.3 LABORATORY DATA

Groundwater, soil, and air samples were collected during the CMS field program and sent off-site for laboratory analyses. The laboratory analyses were as follows:

- Groundwater samples were analyzed for VOCs, SVOCs, and non-regulated constituents (calcium, chemical oxygen demand [COD], alkalinity, total dissolved solids [TDS], total organic carbon, [TOC], and total solids [TS]).
- Air samples were analyzed for VOCs.
- Soil samples were analyzed for grain size distribution.

The groundwater and air sample analyses were performed by Quanterra, Inc. laboratories. Quanterra, Inc. out-sourced the grain size analyses to Applied Construction Technologies, Inc.

3.3.1 Groundwater Analytical Data

Tables 3.4, 3.5, and 3.6, and Figures 3.11 and 3.12 present the groundwater data for VOCs, SVOCs, and non-regulated constituents. Only detected parameters are listed. The entire database of detected and undetected compounds from the analyses of groundwater samples is presented in Appendix D.

3.3.2 Air Data

The data for detected compounds from air sample analyses is presented in Table 3.7. The entire database of detected and undetected compounds from the analyses of air samples is presented in Appendix E. Table 3.8 summarizes the results for all compounds identified in one or more air samples, along with the calculated flux for the compound 1,2-dichloropropane, at the measured detection limits. The emission flux was calculated using the equation shown below:

$$E_i = \frac{Y_i Q}{A}$$

where:

E_i = emission rate of component i, $\mu\text{g}/\text{cm}^2\text{-hr}$

Y_i = concentration of component i in sweep air, mass/volume calculated from volumetric concentration in ppb

Q = sweep air rate, volume/time

A = surface area enclosed by sampling collar, 1297 cm²

The average flux calculated for each location is the arithmetic average of the three samples. No field blank correction was applied.

3.3.3 Grain Size Data

Samples of fill/soil were selected from each soil boring to enable the specific grain size distributions of the distinct stratigraphic units that were encountered during the CMS field drilling program to be assessed. These data will be used during the conceptual design stage of the CMS in the assessment of groundwater containment technologies and alternatives. The grain size distribution data report is presented in Appendix F.

TABLE 3.1
SLUG TEST RESULTS

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

Monitoring Well	Slug In Hydraulic Conductivity (cm/sec)	Slug Out Hydraulic Conductivity (cm/sec)	Representative Hydraulic Conductivity (cm/sec)
● CMS-MW01	--	6.65E-03	6.65E-03
SP CMS-MW02	8.99E-05	6.88E-05	7.87E-05
SP CMS-MW03	--	8.30E-04	8.30E-04
● CMS-MW05	2.05E-05	--	2.05E-05
SP CMS-MW06	--	3.26E-03	3.26E-03
SP CMS-MW07	4.11E-05	--	4.11E-05
CMS-MW08	5.54E-04	--	5.54E-04
CMS-MW09	--	3.97E-02	3.97E-02
SP CMS-MW10	1.40E-04	--	1.40E-04
SP CMS-MW11	2.20E-05	--	2.20E-05
SP CMS-MW12	2.76E-04	--	2.76E-04
CMS-MW13F	--	1.66E-01	1.66E-01
CMS-MW13S	--	8.96E-04	8.96E-04
CMS-MW14S	--	1.41E-03	1.41E-03
CMS-MW15	--	1.19E-02	1.19E-02
CMS-MW16	--	7.04E-04	7.04E-04
CMS-MW18	--	6.52E-03	6.52E-03
● PM4NA	7.55E-05	--	7.55E-05
RFI-MW01	1.70E-03	1.25E-03	1.46E-03
RFI-MW02	8.08E-05	--	8.08E-05
RFI-MW03	1.52E-05	--	1.52E-05
RFI-MW04	1.11E-03	--	1.11E-03
RFI-MW05	3.30E-03	6.36E-03	4.58E-03
RFI-MW06	1.88E-03	3.55E-03	2.58E-03
RFI-MW07	2.66E-05	--	2.66E-05
RFI-MW08	2.80E-03	2.67E-03	2.74E-03
RFI-MW10	8.36E-04	--	8.36E-04
RFI-MW13	2.64E-03	2.16E-03	2.39E-03
RFI-MW14	5.61E-04	--	5.61E-04
RFI-MW22	1.33E-03	--	1.33E-03
RFI-MW23	4.06E-03	4.31E-03	4.18E-03
● RFI-MW29	6.79E-04	--	6.79E-04

Notes:

- (1) Slug test data analyzed using the Bouwer-Rice method.
- (2) Well CMSMW-4 recovered within seconds and was therefore too permeable to quantify hydraulic conductivity using slug testing methods.
- (3) If both slug-in and slug-out tests were performed, the geometric mean is a representative hydraulic conductivity

TABLE 3.2
GROUNDWATER FIELD MEASUREMENTS

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-1 CMSMW-1 19-Aug-99 Water Field Sample A9H210120001 16-Sep-99	CMSMW-2 CMSMW-2 19-Aug-99 Water Field Sample A9H210120003 16-Sep-99	CMSMW-3 CMSMW-3 19-Aug-99 Water Field Sample A9H210120007 16-Sep-99	CMSMW-4 CMSMW-4 20-Aug-99 Water Field Sample A9H240148001 16-Sep-99	CMSMW-5 CMSMW-5 23-Aug-99 Water Field Sample A9H250128004 13-Sep-99	CMSMW-6 CMSMW-6 23-Aug-99 Water Field Sample A9H250128005 13-Sep-99	CMSMW-7 CMSMW-7 24-Aug-99 Water Field Sample A9H260105001 13-Sep-99	CMSMW-8 CMSMW-8 24-Aug-99 Water Field Sample A9H260105002 13-Sep-99	CMSMW-9 CMSMW-9 24-Aug-99 Water Field Sample A9H260105003 13-Sep-99
Analyte										
pH	--	9.93	11.16	6.77	7.66	13.58	11.98	12.13	12.82	11.86
Dissolved Oxygen	mg/L	0.77	2.38	1.17	0.12	NA	7.15	2	6.42	0
Conductivity	mS/cm	5.44	5.08	4.59	5.06	10.5	26.4	9.9	20.8	7.96
Temperature	°C	17.6	17.7	20.4	18.2	12.4	12.8	18.6	17.5	14.8
Oxidation Reduction Potential	mV	-85	-358	-40	-99	NA	-75	-80	NA	-460
Total Iron	mg/L	1.1	2.7	5.7	1.35	1.5	4.8	3.8	6.7	9.8
Ferrous Iron	mg/L	1.6	0.9	1.1	2.87	21.63	25.25	0.45	1.25	6.38

Notes:

NA: Not analyzed

Total iron values for several wells may be underestimated. Results observed at wells CMS-MW05, CMS-MW06, and RFIMW-6 show significantly higher concentrations of ferrous iron than total iron. Since the total iron samples were analyzed last, precipitation may have occurred, resulting in the lower total iron measurements.

TABLE 3.2
GROUNDWATER FIELD MEASUREMENTS

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-10 CMSMW-10 24-Aug-99 Water Field Sample A9H260105005 13-Sep-99	CMSMW-11 CMSMW-11 24-Aug-99 Water Field Sample A9H260105006 13-Sep-99	CMSMW-12 CMSMW-12 25-Aug-99 Water Field Sample A9H1270119001 13-Sep-99	CMSMW-13S CMSMW-13S 23-Aug-99 Water Field Sample A9H250128008 13-Sep-99	CMSMW-13F CMSMW-13F 23-Aug-99 Water Field Sample A9H250128007 13-Sep-99	CMSMW-14S CMSMW-14S 25-Aug-99 Water Field Sample A9H270119002 13-Sep-99	CMSMW-39S CMSMW-39S 25-Aug-99 Water Field Sample A9H270119003 13-Sep-99	CMSMW-15 CMSMW-15 19-Aug-99 Water Field Sample A9H210120005 16-Sep-99	CMSMW-16F CMSMW-16F 24-Aug-99 Water Field Sample A9H260105007 13-Sep-99
Analyte										
pH	--	12.91	13.02	8.51	9.71	9.11	6.45	NA	12.07	10.35
Dissolved Oxygen	mg/L	3.7	3.45	0	NA	2.29	1.17	NA	1.09	0
Conductivity	mS/cm	13.2	31.9	22.4	9.4	2.29	4.26	NA	1.93	8.8
Temperature	°C	16.6	16.6	17.4	17.8	21	17.5	NA	17.7	14.4
Oxidation Reduction Potential	mV	-430	NA	NA	NA	NA	NA	NA	-100	-420
Total Iron	mg/L	4.26	0.86	1.6	3	5.6	20.3	19.8	2.16	5.2
Ferrous Iron	mg/L	5.5	4.01	1.25	1.75	1.88	9.63	12.5	0.22	1.38

Notes:

NA: Not analyzed

Total iron values for several wells may be underestimated. Results observed at wells CMS-MW05, CMS-MW06, and RFIMW-6 show significantly higher concentrations of ferrous iron than total iron. Since the total iron samples were analyzed last, precipitation may have occurred, resulting in the lower total iron measurements.

**TABLE 3.2
GROUNDWATER FIELD MEASUREMENTS**

**BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN**

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-18 CMSMW-18 24-Aug-99 Water Field Sample A9H260105004 13-Sep-99	RFIMW-1 RFIMW-1 19-Aug-99 Water Field Sample A9H210120006 16-Sep-99	RFIMW-4 RFIMW-4 20-Aug-99 Water Field Sample A9H240148004 16-Sep-99	RFIMW-5 RFIMW-5 20-Aug-99 Water Field Sample A9H240148005 16-Sep-99	RFIMW-30 RFIMW-30 20-Aug-99 Water Field Sample A9H240148006 16-Sep-99	RFIMW-6 RFIMW-6 23-Aug-99 Water Field Sample A9H250128003 13-Sep-99	RFIMW-7 RFIMW-7 23-Aug-99 Water Field Sample A9H250128006 13-Sep-99	RFIMW-13 RFIMW-13 19-Aug-99 Water Field Sample A9H210120008 16-Sep-99	RFIMW-14 RFIMW-14 20-Aug-99 Water Field Sample A9H240148002 16-Sep-99
Analyte										
pH	--	11.92	6	6.69	12.91	NA	13.06	13.29	6.78	6.47
Dissolved Oxygen	mg/L	0.06	2.54	2.33	0.86	NA	14.27	NA	0.63	4.76
Conductivity	mS/cm	6.94	40.9	7.49	29.1	NA	6.05	21.7	41.7	91.2
Temperature	°C	17	12.7	18.2	13	NA	14.9	13.2	14	13.8
Oxidation Reduction Potential	mV	NA	-126	-206	-114	NA	48	NA	-142	-106
Total Iron	mg/L	0.7	9.6	1.51	40.2	35.1	11.4	4.69	9.5	25.4
Ferrous Iron	mg/L	1	0.9	1.79	13.35	20.7	40.88	4.35	2.7	10

Notes:

NA: Not analyzed

Total iron values for several wells may be underestimated. Results observed at wells CMS-MW05, CMS-MW06, and RFIMW-6 show significantly higher concentrations of ferrous iron than total iron. Since the total iron samples were analyzed last, precipitation may have occurred, resulting in the lower total iron measurements.

TABLE 3.2
GROUNDWATER FIELD MEASUREMENTS

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

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Section 3, Revision No. 0
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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		RFIMW-39 RFIMW-39 20-Aug-99 Water Field Sample A9H240148003 16-Sep-99	RFIMW-22 RFIMW-22 19-Aug-99 Water Field Sample A9H210120004 16-Sep-99	RFIMW-23 RFIMW-23 19-Aug-99 Water Field Sample A9H210120002 16-Sep-99	RFIMW-29 RFIMW-29 23-Aug-99 Water Field Sample A9H250128001 13-Sep-99	PM4NA PM4NA 23-Aug-99 Water Field Sample A9H250128002 13-Sep-99
Analyte						
pH	—	NA	10.45	5.75	7.01	8.34
Dissolved Oxygen	mg/L	NA	8.09	1.68	6.22	0.55
Conductivity	mS/cm	NA	16.6	4.87	11.2	58.3
Temperature	°C	NA	15.6	16.6	18.3	12.6
Oxidation Reduction Potential	mV	NA	-500	-95	77	NA
Total Iron	mg/L	24	2.8	4.07	4.8	2.9
Ferrous Iron	mg/L	5.05	1.3	0.72	1	3.88

Notes:

NA: Not analyzed

Total iron values for several wells may be underestimated. Results observed at wells CMS-MW05, CMS-MW06, and RFIMW-6 show significantly higher concentrations of ferrous iron than total iron. Since the total iron samples were analyzed last, precipitation may have occurred, resulting in the lower total iron measurements.

TABLE 3.3
GROUNDWATER ELEVATIONS
NOVEMBER 1999

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

Location Number	Coordinates		TOC Elevation (feet)	DTW 12/1/1999 (feet)	Groundwater Elevation 12/1/1999 (feet)	Screened Unit
	Northing (feet)	Easting (feet)				
P-4-N	-1682.18	163.63	578.42	5.48	572.94	F&NS
P-5-N	-1628.18	464.33	580.72	8.30	572.42	F&NS
✓ P-6-N	-1544.07	834.20	578.50	5.59	572.91	Fill
✓ P-7-N*	-1441.18	1249.18	580.48	8.30	572.18	Fill
✓ P-8-N	-2004.97	1134.48	577.86	6.29	571.57	Fill
✓ P-11-N	-1119.09	-86.52	576.04	3.49	572.55	Native Sand
P-15-N	-506.54	-33.07	577.73	4.81	572.92	F&NS
→ P-16-N	606.69	885.40	586.99	8.77	578.22	Fill
P-24-N	1132.61	-24.43	580.96	4.72	576.24	F&NS
P-26-N	2019.77	350.53	581.38	6.32	575.06	F&NS
P-27-N	2378.13	100.32	583.17	8.32	574.85	F&NS
✓ P-28-N	3112.30	319.25	578.16	6.18	571.98	Native Sand
✓ P-29-N	3111.78	314.79	578.71	6.28	572.43	Fill
P-31-N	2885.76	-596.22	584.71	7.51	577.20	F&NS
P-34-N	-1800.52	-459.21	575.99	3.30	572.69	F(?)&NS(?)
✓ P-36-N	67.30	-462.95	579.43	5.14	574.29	F(?)&NS(?)
✓ P-38-N	2680.17	-343.31	584.17	7.75	576.42	Fill
P-39-N	1208.69	348.34	581.28	5.18	576.10	F&NS
P-46-N ←	-1697.88	1194.52	578.61	6.90	571.71	Native Sand
P-1-NA	-1868.25	693.68	580.56	7.41	573.15	Native Sand
✓ P-2-NA*	-1734.42	189.34	576.58	3.84	572.74	Native Sand
✓ PM-1-NA	-1911.72	796.52	578.70	5.92	572.78	Native Sand
✓ PM-2-NA* ←	-1358.92	497.01	579.90	4.60	575.30	Native Sand
✓ PM-3-NA*	-1745.43	69.38	576.11	3.26	572.85	Native Sand
✓ PM-4-NA	-1911.61	791.39	578.69	5.16	573.53	Native Sand
✓ P-1-NB	127.40	994.17	576.25	2.96	573.29	Native Sand
✓ P-3-NB	216.64	-15.66	577.45	3.75	573.70	Native Sand
✓ PM-1-NB	3.63	998.27	576.06	2.66	573.40	Native Sand
✓ PM-2-NB ←	557.22	450.90	582.66	3.43	579.23	Native Sand
✓ PM-3-NB	219.35	-83.48	577.93	4.16	573.77	Native Sand
✓ P-1-NC	1707.29	-197.69	582.41	5.56	576.85	Native Sand
✓ P-2-NC	1789.55	292.86	580.86	5.51	575.35	Native Sand
✓ PM-1-NC*	1774.29	365.00	580.58	4.99	575.59	Native Sand
✓ PM-2-NC ←	2047.08	-44.52	579.65	8.21	571.44	Native Sand
✓ PM-3-NC	1779.64	-340.12	579.60	2.71	576.89	NS(?)
E-1-NA	-1801.26	632.68	577.71	7.08	570.63	Native Sand
E-2-NA	-1502.51	514.47	579.37	6.75	572.62	Native Sand
E-3-NA	-1679.49	430.03	578.89	8.63	570.26	Native Sand
E-4-NA	-1857.34	324.83	577.93	9.04	568.89	Native Sand
E-5-NB*	437.86	143.91	579.30	5.71	573.59	Native Sand
E-6-NB	354.73	120.56	577.23	3.58	573.65	Native Sand
E-7-NB	157.33	145.17	576.38	3.00	573.38	Native Sand
E-8-NB*	-94.56	123.04	578.23	4.52	573.71	Native Sand
E-9-NB	358.95	328.18	577.42	3.61	573.81	Native Sand
E-10-NB	118.46	326.47	576.80	4.29	572.51	Native Sand
E-11-NB	118.01	553.73	577.04	4.07	572.97	Native Sand
E-13-NB	79.24	934.28	576.32	3.75	572.57	Native Sand
E-14-NC	1651.44	65.98	579.96	14.55	565.41	Native Sand
E-15-NC	1603.81	-87.03	581.62	13.58	568.04	Native Sand
PE-1-NA	-1823.53	643.41	580.32	7.84	572.48	Native Sand
PE-2-NA	-1484.43	494.48	579.87	7.32	572.55	Native Sand
PE-3-NA	-1704.18	428.38	579.9	7.74	572.16	Native Sand
PE-4-NA	-1875.41	321.57	578.81	5.31	573.50	Native Sand
✓ PE-5-NB*	437.11	152.28	578.57	4.92	573.65	Native Sand

TABLE 3.3
GROUNDWATER ELEVATIONS
NOVEMBER 1999

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

Location Number	Coordinates		TOC Elevation (feet)	DTW 12/1/1999 (feet)	Groundwater Elevation 12/1/1999 (feet)	Screened Unit
	Northing (feet)	Easting (feet)				
PE-6-NB ✓	331.8	119.73	578.53	4.46	574.07	Native Sand
PE-7-NB* ✓	161.83	158.53	578.11	4.74	573.37	Native Sand
PE-8-NB* ✓	-94.21	130.47	576.86	4.88	571.98	Native Sand
PE-9-NB* ✓	358.66	318.2	578.21	4.02	574.19	Native Sand
PE-10-NB ✓	97.8	325.84	578.19	5.06	573.13	Native Sand
PE-11-NB ✓	108.44	544.52	578.63	5.50	573.13	Native Sand
PE-13-NB ✓	78.44	923.08	577.64	4.58	573.06	Native Sand
PE-14-NC ✓	1666.27	61.62	583.38	7.17	576.21	Native Sand
RFIMW-1 ✓	3095.92	289.26	576.67	4.42	572.25	Native Sand
RFIMW-2 ✓	2631.09	449.68	580.05	6.42	573.63	Native Sand
RFIMW-3 ✓	2359.68	659.29	581.06	7.50	573.56	Native Sand
RFIMW-4 ✓	1930.49	950.05	580.39	8.02	572.37	Fill
RFIMW-5 ✓	1560.33	1201.34	582.21	10.30	571.91	Fill
RFIMW-6 ✓	1162.00	1499.81	581.30	9.68	571.62	Fill
RFIMW-7 ✓	610.41	1554.96	589.39	16.93	572.46	Fill
RFIMW-8 ✓	25.29	1687.35	580.95	9.74	571.21	Native Sand
RFIMW-9 ✓	-547.32	1590.80	579.09	8.11	570.98	Native Sand
RFIMW-10 ✓	-1116.28	1499.81	581.92	10.53	571.39	Native Sand
RFIMW-11 ✓	-1483.05	1342.37	577.78	6.34	571.44	Native Sand
RFIMW-12 ✓	-2125.45	1156.76	579.89	8.74	571.15	Fill
RFIMW-13 ✓	2887.91	225.53	577.78	4.16	573.62	Native Sand
RFIMW-14 ✓	2363.66	453.17	581.76	7.71	574.05	Native Sand
RFIMW-15F ✓	1641.30	867.87	584.51	9.93	574.58	Fill
RFIMW-16 ✓	1287.44	738.21	587.62	11.81	575.81	Native Sand
RFIMW-17 ✓	796.67	1002.85	586.87	9.69	577.18	Native Sand
RFIMW-18 ✓	-81.14	1396.54	579.04	5.39	573.65	F&NS
RFIMW-19 ✓	-525.33	1379.44	578.52	5.30	573.22	Fill
RFIMW-20 ✓	-1313.52	1184.92	579.52	7.02	572.50	Fill
RFIMW-21 ✓	468.17	872.34	586.00	12.16	573.84	Native Sand
RFIMW-22 ✓	3093.83	-87.52	577.15	4.08	573.07	Native Sand
RFIMW-23 ✓	3063.08	-419.66	582.17	7.65	574.52	Native Sand
RFIMW-24 ✓	2824.37	-590.52	582.37	5.04	577.33	Native Sand
RFIMW-25 ✓	1519.71	-565.54	581.34	3.18	578.16	Native Sand
RFIMW-26 ✓	474.68	-578.45	581.96	4.35	577.61	Native Sand
RFIMW-27 ✓	-607.54	-66.63	577.03	4.56	572.47	Native Sand
RFIMW-28 ✓	-1710.93	-34.10	577.41	4.68	572.73	Native Sand
RFIMW-29 ✓	-2195.30	-13.42	579.62	6.65	572.97	Native Sand
RFIMW-PZ1 ✓	2734.01	269.26	582.06	8.10	573.96	Native Sand
✓TW-1	2124.07	28.05	583.95	6.94	577.01	Fill
TW-2	2585.7	57.5	583.81	8.90	574.91	F&NS
TW-3	2071.61	-112.01	581.71	--	--	F&NS
✓TW-4	2274.82	-276.08	577.98	4.92	573.06	Fill
✓TW-5	2009.51	-118.36	581.15	4.69	576.46	Fill
PW-1 ✓	2070.82	-63.38	582.65	5.63	577.02	F&NS
DNR-2 ✓	1669.98	-618.51	583.59	5.47	578.12	Native Sand
✓DNR-6*	1649.06	436.2	582.75	7.34	575.41	Fill
DNR-?	208.90	189.11	578.51	4.85	573.66	
River N (Alkali)*	0		577.34	6.20	571.14	River
River S (Corps)*	-1500		577.65	6.30	571.35	River
✓CMS-MW-1	N 3063.10	W 414.13	582.36	7.84	574.52	Fill
✓CMS-MW-2	N 3092.74	W 93.20	577.34	3.14	574.20	Fill
✓CMS-MW-3	N 2883.45	E 225.44	578.08	4.12	573.96	Fill
✓CMS-MW-4	N 2368.64	E 453.45	581.78	7.39	574.39	Fill
✓CMS-MW-5	N 1164.21	E 1366.79	583.27	11.12	572.15	Fill
✓CMS-MW-6	N 631.85	E 1518.55	587.55	14.90	572.65	Fill

TABLE 3.3
GROUNDWATER ELEVATIONS
NOVEMBER 1999

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

Location Number	Coordinates		TOC Elevation (feet)	DTW 12/1/1999 (feet)	Groundwater Elevation 12/1/1999 (feet)	Screened Unit
	Northing (feet)	Easting (feet)				
CMS-MW-7	N 7.00	E 1511.32	579.93	7.90	572.03	Fill
CMS-MW-8	S 606.21	E 1486.34	579.26	7.04	572.22	Fill
CMS-MW-9	S 1154.48	E 1288.35	580.21	8.48	571.73	Fill
CMS-MW-10	S 1445.48	E 1275.44	579.17	7.21	571.96	Fill
CMS-MW-11	S 2133.24	E 1116.53	579.02	7.93	571.09	Fill
CMS-MW-12	S 1906.47	E 790.05	578.79	5.07	573.72	Fill
CMS-MW-13S	S 1958.96	E 425.29	579.80	7.07	572.73	Native Sand
✓CMS-MW-13F	S 1954.11	E 423.94	579.50	6.26	573.24	Fill
CMS-MW-14S	S 1985.74	E 166.84	579.39	6.19	573.20	Native Sand
✓CMS-MW-15	N 3096.78	E 292.95	577.01	4.11	572.90	Fill
✓CMS-MW-16	N 1623.65	E 931.14	584.15	9.25	574.90	Fill
✓CMS-MW-18	S 918.37	E 1425.98	580.02	7.41	572.61	F&NS (?)

1. Water levels measured on November 30 and December 1, 1999.
2. All elevations are referenced to the International Great Lakes Datum (IGLD).
3. Last heavy precipitation preceding survey was on November 21.
4. Choices for screened interval are either Fill or Native Sand.
Where it is not clear which unit is monitored, the more likely unit is listed with a question mark.
5. Well P-7-N heaved. Cement well seal almost entirely out of the ground.
6. PE-7-NB and PE-9-NB were measured on December 1 but the extraction well was measured on November 30.
7. Extraction wells 1 through 13 were not operating during survey. Carbon changed on 11/30. System restarted 4:30PM 11/30.
Extractions wells 14 and 15 were operating when surveyed on December 1.
8. TW-3 was obstructed at 4.70 feet; logged at 14 feet deep from top casing.
9. TW-5 heaved. Cement pad approximately 0.5 feet above grade.
10. RFIMW-29 may not have recovered fully, as some water was removed from the well when the bailer was withdrawn.

TABLE 3.4
INFORMATION FOR WELLS USED IN THE
DEVELOPMENT OF THE GROUNDWATER
CONTOUR MAP FOR THE FILL UNIT

Location Number	Coordinates		Elevation Well Top (feet)	Depth to Water 01-Dec-99 (feet)	Elevation Groundwater 01-Dec-99 (feet)
	North/South (feet)	East/West (feet)			
P-6-N	-1544.07	834.20	578.50	5.59	572.91
P-7-N*	-1441.18	1249.18	580.48	8.30	572.18
P-8-N	-2004.97	1134.48	577.86	6.29	571.57
P-29-N	3111.78	314.79	578.71	6.28	572.43
P-38-N	2680.17	-343.31	584.17	7.75	576.42
RFIMW-4	1930.49	950.05	580.39	8.02	572.37
RFIMW-5	1560.33	1201.34	582.21	10.30	571.91
RFIMW-6	1162.00	1499.81	581.30	9.68	571.62
RFIMW-7	610.41	1554.96	589.39	16.93	572.46
RFIMW-12	-2125.45	1156.76	579.89	8.74	571.15
RFIMW-19	-525.33	1379.44	578.52	5.30	573.22
RFIMW-20	-1313.52	1184.92	579.52	7.02	572.50
TW-1	2124.07	28.05	583.95	6.94	577.01
TW-4	2274.82	-276.08	577.98	4.92	573.06
TW-5	2009.51	-118.36	581.15	4.69	576.46
DNR-6*	1649.06	436.2	582.75	7.34	575.41
CMS-MW-1	3063.1	-414.13	582.36	7.84	574.52
CMS-MW-2	3092.74	-93.2	577.34	3.14	574.20
CMS-MW-3	2883.45	225.44	578.08	4.12	573.96
CMS-MW-4	2368.64	453.45	581.78	7.39	574.39
CMS-MW-5	1164.21	1366.79	583.27	11.12	572.15
CMS-MW-6	631.85	1518.55	587.55	14.90	572.65
CMS-MW-7	7	1511.32	579.93	7.90	572.03
CMS-MW-8	-606.21	1486.34	579.26	7.04	572.22
CMS-MW-9	-1154.48	1288.35	580.21	8.48	571.73
CMS-MW-10	-1445.48	1275.44	579.17	7.21	571.96
CMS-MW-11	-2133.24	1116.53	579.02	7.93	571.09
CMS-MW-12	-1906.47	790.05	578.79	5.07	573.72
CMS-MW-13F	-1954.11	423.94	579.50	6.26	573.24
CMS-MW-15	3096.78	292.95	577.01	4.11	572.90
CMS-MW-16	1623.65	931.14	584.15	9.25	574.90
CMS-MW-18	-918.37	1425.98	580.02	7.41	572.61

TABLE 3.5
INFORMATION FOR WELLS USED IN THE
DEVELOPMENT OF THE GROUNDWATER
CONTOUR MAP FOR THE NATIVE SAND UNIT

Location Number	Coordinates		Top of Well Casing Elevation (feet)	Depth to Water 01-Dec-99 (feet)	Groundwater Elevation 01-Dec-99 (feet)
	North/South (feet)	East/West (feet)			
P-11-N	-1119.09	-86.52	576.04	3.49	572.55
P-28-N	3112.30	319.25	578.16	6.18	571.98
P-1-NA	-1868.25	693.68	580.56	7.41	573.15
P-2-NA*	-1734.42	189.34	576.58	3.84	572.74
PM-1-NA	-1911.72	796.52	578.70	5.92	572.78
PM-3-NA*	-1745.43	69.38	576.11	3.26	572.85
PM-4-NA	-1911.61	791.39	578.69	5.16	573.53
P-1-NB	127.40	994.17	576.25	2.96	573.29
P-3-NB	216.64	-15.66	577.45	3.75	573.70
PM-1-NB	3.63	998.27	576.06	2.66	573.40
PM-3-NB	219.35	-83.48	577.93	4.16	573.77
P-1-NC	1707.29	-197.69	582.41	5.56	576.85
P-2-NC	1789.55	292.86	580.86	5.51	575.35
PM-1-NC*	1774.29	365.00	580.58	4.99	575.59
PM-3-NC	1779.64	-340.12	579.60	2.71	576.89
PE-4-NA	-1875.41	321.57	578.81	5.31	573.50
PE-5-NB*	437.11	152.28	578.57	4.92	573.65
PE-6-NB	331.8	119.73	578.53	4.46	574.07
PE-7-NB*	161.83	158.53	578.11	4.74	573.37
PE-9-NB*	358.66	318.2	578.21	4.02	574.19
PE-10-NB	97.8	325.84	578.19	5.06	573.13
PE-11-NB	108.44	544.52	578.63	5.50	573.13
PE-13-NB	78.44	923.08	577.64	4.58	573.06
PE-14-NC	1666.27	61.62	583.38	7.17	576.21
RFIMW-1	3095.92	289.26	576.67	4.42	572.25
RFIMW-2	2631.09	449.68	580.05	6.42	573.63
RFIMW-3	2359.68	659.29	581.06	7.50	573.56
RFIMW-13	2887.91	225.53	577.78	4.16	573.62
RFIMW-14	2363.66	453.17	581.76	7.71	574.05
RFIMW-16	1287.44	738.21	587.62	11.81	575.81
RFIMW-21	468.17	872.34	586.00	12.16	573.84
RFIMW-22	3093.83	-87.52	577.15	4.08	573.07
RFIMW-23	3063.08	-419.66	582.17	7.65	574.52
RFIMW-24	2824.37	-590.52	582.37	5.04	577.33
RFIMW-25	1519.71	-565.54	581.34	3.18	578.16
RFIMW-26	474.68	-578.45	581.96	4.35	577.61
RFIMW-28	-1710.93	-34.10	577.41	4.68	572.73
RFIMW-29	-2195.30	-13.42	579.62	6.65	572.97
RFIMW-PZ1	2734.01	269.26	582.06	8.10	573.96
DNR-2	1669.98	-618.51	583.59	5.47	578.12
CMS-MW-13S	S 1958.96	E 425.29	579.80	7.07	572.73
CMS-MW-14S	S 1985.74	E 166.84	579.39	6.19	573.20

TABLE 3.6
 SUMMARY OF GROUNDWATER SAMPLING RESULTS
 VOLATILE ORGANIC COMPOUNDS

BASF NORTH WORKS FACILITY
 WYANDOTTE, MICHIGAN

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-1 CMSMW-1 19-Aug-99 Water Field Sample A9H210120001 16-Sep-99	CMSMW-2 CMSMW-2 19-Aug-99 Water Field Sample A9H210120003 16-Sep-99	CMSMW-3 CMSMW-3 19-Aug-99 Water Field Sample A9H210120007 16-Sep-99	CMSMW-4 CMSMW-4 20-Aug-99 Water Field Sample A9H240148001 16-Sep-99	CMSMW-5 CMSMW-5 23-Aug-99 Water Field Sample A9H250128004 13-Sep-99	CMSMW-6 CMSMW-6 23-Aug-99 Water Field Sample A9H250128005 13-Sep-99	CMSMW-7 CMSMW-7 24-Aug-99 Water Field Sample A9H260105001 13-Sep-99	CMSMW-8 CMSMW-8 24-Aug-99 Water Field Sample A9H260105002 13-Sep-99	CMSMW-9 CMSMW-9 24-Aug-99 Water Field Sample A9H260105003 13-Sep-99
Analyte										
VOCs										
1,1-Dichloroethene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Acetone	ug/L	940 J	27 J	NA	NA	NA	NA	NA	NA	NA
Benzene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Bromomethane	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Chloroform	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
o-Xylene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Styrene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Toluene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA

TABLE 3.6
 SUMMARY OF GROUNDWATER SAMPLING RESULTS
 VOLATILE ORGANIC COMPOUNDS

BASF NORTH WORKS FACILITY
 WYANDOTTE, MICHIGAN

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-10 CMSMW-10 24-Aug-99 Water Field Sample A9H260105005 13-Sep-99	CMSMW-11 CMSMW-11 24-Aug-99 Water Field Sample A9H260105006 13-Sep-99	CMSMW-12 CMSMW-12 25-Aug-99 Water Field Sample A9H270119001 13-Sep-99	CMSMW-13S CMSMW-13S 23-Aug-99 Water Field Sample A9H250128008 13-Sep-99	CMSMW-13F CMSMW-13F 23-Aug-99 Water Field Sample A9H250128007 13-Sep-99	CMSMW-14S CMSMW-14S 25-Aug-99 Water Field Sample A9H270119002 13-Sep-99	CMSMW-39S CMSMW-39S 25-Aug-99 Water Field Sample A9H270119003 13-Sep-99	CMSMW-15 CMSMW-15 19-Aug-99 Water Field Sample A9H210120005 16-Sep-99	CMSMW-16F CMSMW-16F 24-Aug-99 Water Field Sample A9H260105007 13-Sep-99
Analyte										
VOCs										
1,1-Dichloroethene	ug/L	NA	NA	--	--	--	--	--	--	NA
1,2-Dichloropropane	ug/L	NA	NA	--	--	--	0.48 J	0.56 J	--	NA
1,4-Dichlorobenzene	ug/L	NA	NA	--	--	--	--	--	--	NA
Acetone	ug/L	NA	NA	--	83 J	--	420 J	510 J	--	NA
Benzene	ug/L	NA	NA	--	66	--	--	--	--	NA
Bromodichloromethane	ug/L	NA	NA	--	--	--	--	--	--	NA
Bromomethane	ug/L	NA	NA	--	--	--	--	--	--	NA
Carbon disulfide	ug/L	NA	NA	1.5 J	--	--	--	--	--	NA
Chlorobenzene	ug/L	NA	NA	--	--	--	--	--	--	NA
Chloroform	ug/L	NA	NA	--	--	--	--	--	--	NA
Ethylbenzene	ug/L	NA	NA	--	--	--	--	--	2.8 J	NA
Methylene chloride	ug/L	NA	NA	14 U*	7.6 U*	39 U*	--	--	--	NA
o-Xylene	ug/L	NA	NA	--	0.68 J	--	--	--	--	NA
Styrene	ug/L	NA	NA	--	--	--	--	--	3.6 J	NA
Toluene	ug/L	NA	NA	--	--	--	--	--	--	NA
Trichloroethene	ug/L	NA	NA	--	--	--	--	--	--	NA
Vinyl chloride	ug/L	NA	NA	--	--	--	--	--	--	NA

TABLE 3.6
 SUMMARY OF GROUNDWATER SAMPLING RESULTS
 VOLATILE ORGANIC COMPOUNDS

BASF NORTH WORKS FACILITY
 WYANDOTTE, MICHIGAN

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-18 CMSMW-18 24-Aug-99 Water Field Sample A9H260105004 13-Sep-99	RFIMW-1 RFIMW-1 19-Aug-99 Water Field Sample A9H210120006 16-Sep-99	RFIMW-4 RFIMW-4 20-Aug-99 Water Field Sample A9H240148004 16-Sep-99	RFIMW-5 RFIMW-5 20-Aug-99 Water Field Sample A9H240148005 16-Sep-99	RFIMW-30 RFIMW-30 20-Aug-99 Water Field Sample A9H240148006 16-Sep-99	RFIMW-6 RFIMW-6 23-Aug-99 Water Field Sample A9H250128003 13-Sep-99	RFIMW-7 RFIMW-7 23-Aug-99 Water Field Sample A9H250128006 13-Sep-99	RFIMW-13 RFIMW-13 19-Aug-99 Water Field Sample A9H210120008 16-Sep-99	RFIMW-14 RFIMW-14 20-Aug-99 Water Field Sample A9H240148002 16-Sep-99
Analyte										
VOCs										
1,1-Dichloroethene	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Acetone	ug/L	NA	240 J	NA	NA	NA	NA	NA	NA	NA
Benzene	ug/L	NA	120	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Bromomethane	ug/L	NA	2.7 J	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Chloroform	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
o-Xylene	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Styrene	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Toluene	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride	ug/L	NA	9.4 J	NA	NA	NA	NA	NA	NA	NA

TABLE 3.6
SUMMARY OF GROUNDWATER SAMPLING RESULTS
VOLATILE ORGANIC COMPOUNDS

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		RFIMW-39 RFIMW-39 20-Aug-99 Water Field Sample A9H240148003 16-Sep-99	RFIMW-22 RFIMW-22 19-Aug-99 Water Field Sample A9H210120004 16-Sep-99	RFIMW-23 RFIMW-23 19-Aug-99 Water Field Sample A9H210120002 16-Sep-99	RFIMW-29 RFIMW-29 23-Aug-99 Water Field Sample A9H250128001 13-Sep-99	PM4NA PM4NA 23-Aug-99 Water Field Sample A9H250128002 13-Sep-99	TRIP BLANK TRIP BLANK 19-Aug-99 Water A9H210120009 30-Aug-99	TRIP BLANK TRIP BLANK 25-Aug-99 Water A9H270119005 31-Aug-99	ERB-1 Equipment Rinseate 25-Aug-99 Water A9H270119004 13-Sep-99
Analyte									
VOCs									
1,1-Dichloroethene	ug/L	NA	--	--	--	--	--	--	--
1,2-Dichloropropane	ug/L	NA	--	--	--	--	--	--	--
1,4-Dichlorobenzene	ug/L	NA	--	--	--	--	--	--	--
Acetone	ug/L	NA	9000 J	--	--	--	--	--	--
Benzene	ug/L	NA	2600 J	--	--	--	0.25 J	--	0.25 J
Bromodichloromethane	ug/L	NA	--	--	--	--	--	--	1.2 J
Bromomethane	ug/L	NA	--	--	--	--	--	--	--
Carbon disulfide	ug/L	NA	--	--	--	--	--	--	--
Chlorobenzene	ug/L	NA	--	--	--	--	--	--	0.34 J
Chloroform	ug/L	NA	--	--	--	--	--	--	38
Ethylbenzene	ug/L	NA	--	--	--	--	--	--	--
Methylene chloride	ug/L	NA	--	--	4.6 U*	30 U*	8	0.98 J	13
o-Xylene	ug/L	NA	--	--	--	--	--	--	--
Styrene	ug/L	NA	--	--	--	--	--	--	0.28 J
Toluene	ug/L	NA	110 U*	--	--	--	--	--	0.6 J
Trichloroethene	ug/L	NA	--	--	--	--	--	--	--
Vinyl chloride	ug/L	NA	370 J	--	--	--	--	--	--

TABLE 3.7
 SUMMARY OF GROUNDWATER SAMPLING RESULTS
 SEMIVOLATILE ORGANIC COMPOUNDS

BASF NORTH WORKS FACILITY
 WYANDOTTE, MICHIGAN

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-1 CMSMW-1 19-Aug-99 Water Field Sample A9H210120001 16-Sep-99	CMSMW-2 CMSMW-2 19-Aug-99 Water Field Sample A9H210120003 16-Sep-99	CMSMW-3 CMSMW-3 19-Aug-99 Water Field Sample A9H210120007 16-Sep-99	CMSMW-4 CMSMW-4 20-Aug-99 Water Field Sample A9H240148001 16-Sep-99	CMSMW-5 CMSMW-5 23-Aug-99 Water Field Sample A9H250128004 13-Sep-99	CMSMW-6 CMSMW-6 23-Aug-99 Water Field Sample A9H250128005 13-Sep-99	CMSMW-7 CMSMW-7 24-Aug-99 Water Field Sample A9H260105001 13-Sep-99	CMSMW-8 CMSMW-8 24-Aug-99 Water Field Sample A9H260105002 13-Sep-99	CMSMW-9 CMSMW-9 24-Aug-99 Water Field Sample A9H260105003 13-Sep-99
Analyte										
SVOCs										
1,2,4-Trichlorobenzene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
1,4-Dioxane	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
2-Picoline	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
bis(2-Chloroisopropyl) ether	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl) phthalate	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Naphthalene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodi-n-propylamine	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Phenol	ug/L	--	24	NA	NA	NA	NA	NA	NA	NA
Pyrene	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA
Pyridine	ug/L	--	--	NA	NA	NA	NA	NA	NA	NA

TABLE 3.7
SUMMARY OF GROUNDWATER SAMPLING RESULTS
SEMIVOLATILE ORGANIC COMPOUNDS

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-10 CMSMW-10 24-Aug-99 Water Field Sample A9H260105005 13-Sep-99	CMSMW-11 CMSMW-11 24-Aug-99 Water Field Sample A9H260105006 13-Sep-99	CMSMW-12 CMSMW-12 25-Aug-99 Water Field Sample A9H270119001 13-Sep-99	CMSMW-13S CMSMW-13S 23-Aug-99 Water Field Sample A9H250128008 13-Sep-99	CMSMW-13F CMSMW-13F 23-Aug-99 Water Field Sample A9H250128007 13-Sep-99	CMSMW-14S CMSMW-14S 25-Aug-99 Water Field Sample A9H270119002 13-Sep-99	CMSMW-39S CMSMW-39S 25-Aug-99 Water Field Sample A9H270119003 13-Sep-99	CMSMW-15 CMSMW-15 19-Aug-99 Water Field Sample A9H210120005 16-Sep-99	CMSMW-16F CMSMW-16F 24-Aug-99 Water Field Sample A9H260105007 13-Sep-99
Analyte										
SVOCs										
1,2,4-Trichlorobenzene	ug/L	NA	NA	--	--	--	--	--	--	NA
1,4-Dioxane	ug/L	NA	NA	--	--	--	--	--	4.8 J	NA
2,4-Dimethylphenol	ug/L	NA	NA	--	5.5	--	--	--	--	NA
2,4-Dinitrotoluene	ug/L	NA	NA	--	--	--	--	--	--	NA
2-Chlorophenol	ug/L	NA	NA	--	--	--	--	--	--	NA
2-Picoline	ug/L	NA	NA	--	29	--	--	--	--	NA
4-Chloro-3-methylphenol	ug/L	NA	NA	--	--	--	--	--	--	NA
4-Nitrophenol	ug/L	NA	NA	--	--	--	--	--	--	NA
Acenaphthene	ug/L	NA	NA	--	--	--	--	--	--	NA
Benzo(a)anthracene	ug/L	NA	NA	--	--	--	--	--	--	NA
bis(2-Chloroisopropyl) ether	ug/L	NA	NA	--	--	--	6.5 J	5.3 J	--	NA
bis(2-Ethylhexyl) phthalate	ug/L	NA	NA	--	--	--	--	--	--	NA
Fluoranthene	ug/L	NA	NA	--	--	--	--	--	--	NA
Naphthalene	ug/L	NA	NA	--	--	19	5.9	5.4	--	NA
N-Nitrosodi-n-propylamine	ug/L	NA	NA	--	--	--	--	--	--	NA
Pentachlorophenol	ug/L	NA	NA	--	--	--	--	--	--	NA
Phenol	ug/L	NA	NA	--	--	--	--	--	--	NA
Pyrene	ug/L	NA	NA	--	--	--	--	--	--	NA
Pyridine	ug/L	NA	NA	--	3.6 J	--	--	--	--	NA

TABLE 3.7
 SUMMARY OF GROUNDWATER SAMPLING RESULTS
 SEMIVOLATILE ORGANIC COMPOUNDS

BASF NORTH WORKS FACILITY
 WYANDOTTE, MICHIGAN

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-18 CMSMW-18 24-Aug-99 Water Field Sample A9H260105004 13-Sep-99	RFIMW-1 RFIMW-1 19-Aug-99 Water Field Sample A9H210120006 16-Sep-99	RFIMW-4 RFIMW-4 20-Aug-99 Water Field Sample A9H240148004 16-Sep-99	RFIMW-5 RFIMW-5 20-Aug-99 Water Field Sample A9H240148005 16-Sep-99	RFIMW-30 RFIMW-30 20-Aug-99 Water Field Sample A9H240148006 16-Sep-99	RFIMW-6 RFIMW-6 23-Aug-99 Water Field Sample A9H250128003 13-Sep-99	RFIMW-7 RFIMW-7 23-Aug-99 Water Field Sample A9H250128006 13-Sep-99	RFIMW-13 RFIMW-13 19-Aug-99 Water Field Sample A9H210120008 16-Sep-99	RFIMW-14 RFIMW-14 20-Aug-99 Water Field Sample A9H240148002 16-Sep-99
Analyte										
SVOCs										
1,2,4-Trichlorobenzene	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
1,4-Dioxane	ug/L	NA	120 J	NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
2-Picoline	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
bis(2-Chloroisopropyl) ether	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl) phthalate	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Naphthalene	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodi-n-propylamine	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Phenol	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Pyrene	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA
Pyridine	ug/L	NA	--	NA	NA	NA	NA	NA	NA	NA

TABLE 3.7
 SUMMARY OF GROUNDWATER SAMPLING RESULTS
 SEMIVOLATILE ORGANIC COMPOUNDS

BASF NORTH WORKS FACILITY
 WYANDOTTE, MICHIGAN

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		RFIMW-39 RFIMW-39 20-Aug-99 Water Field Sample A9H240148003 16-Sep-99	RFIMW-22 RFIMW-22 19-Aug-99 Water Field Sample A9H210120004 16-Sep-99	RFIMW-23 RFIMW-23 19-Aug-99 Water Field Sample A9H210120002 16-Sep-99	RFIMW-29 RFIMW-29 23-Aug-99 Water Field Sample A9H250128001 13-Sep-99	PM4NA PM4NA 23-Aug-99 Water Field Sample A9H250128002 13-Sep-99	TRIP BLANK TRIP BLANK 19-Aug-99 Water A9H210120009 30-Aug-99	TRIP BLANK TRIP BLANK 25-Aug-99 Water A9H270119005 31-Aug-99	ERB-1 Equipment Rinseate 25-Aug-99 Water A9H270119004 13-Sep-99
Analyte									
SVOCs									
1,2,4-Trichlorobenzene	ug/L	NA	--	--	--	--	NA	NA	--
1,4-Dioxane	ug/L	NA	87 J	--	--	--	NA	NA	--
2,4-Dimethylphenol	ug/L	NA	--	--	--	--	NA	NA	--
2,4-Dinitrotoluene	ug/L	NA	--	--	--	--	NA	NA	--
2-Chlorophenol	ug/L	NA	--	--	--	--	NA	NA	--
2-Picoline	ug/L	NA	--	--	--	--	NA	NA	--
4-Chloro-3-methylphenol	ug/L	NA	--	--	--	--	NA	NA	--
4-Nitrophenol	ug/L	NA	--	--	--	--	NA	NA	--
Acenaphthene	ug/L	NA	--	--	--	--	NA	NA	--
Benzo(a)anthracene	ug/L	NA	--	3.3 J	--	--	NA	NA	--
bis(2-Chloroisopropyl) ether	ug/L	NA	--	--	--	--	NA	NA	--
bis(2-Ethylhexyl) phthalate	ug/L	NA	--	--	--	--	NA	NA	--
Fluoranthene	ug/L	NA	--	4.5 J	--	--	NA	NA	--
Naphthalene	ug/L	NA	--	--	--	--	NA	NA	--
N-Nitrosodi-n-propylamine	ug/L	NA	--	--	--	--	NA	NA	--
Pentachlorophenol	ug/L	NA	--	--	--	--	NA	NA	--
Phenol	ug/L	NA	220 J	--	--	--	NA	NA	--
Pyrene	ug/L	NA	--	9.6	--	--	NA	NA	--
Pyridine	ug/L	NA	--	--	--	--	NA	NA	--

TABLE 3.8
SUMMARY OF GROUNDWATER SAMPLING RESULTS
NON-REGULATED CONSTITUENTS

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-1 CMSMW-1 19-Aug-99 Water Field Sample A9H210120001 16-Sep-99	CMSMW-1 DUP CMSMW-1 DUP 19-Aug-99 Water Field Sample A9H210120001X 25-Aug-99	CMSMW-2 CMSMW-2 19-Aug-99 Water Field Sample A9H210120003 16-Sep-99	CMSMW-3 CMSMW-3 19-Aug-99 Water Field Sample A9H210120007 16-Sep-99	CMSMW-4 CMSMW-4 20-Aug-99 Water Field Sample A9H240148001 16-Sep-99	CMSMW-5 CMSMW-5 23-Aug-99 Water Field Sample A9H250128004 13-Sep-99	CMSMW-6 CMSMW-6 23-Aug-99 Water Field Sample A9H250128005 13-Sep-99	CMSMW-7 CMSMW-7 24-Aug-99 Water Field Sample A9H260105001 13-Sep-99	CMSMW-8 CMSMW-8 24-Aug-99 Water Field Sample A9H260105002 13-Sep-99
Analyte										
Non-Regulated Compounds										
Calcium	mg/L	539	NA	420	404	857	1710	2230	451	112
Chemical Oxygen Demand (COD)	mg/L	49.2	NA	147	247	127	125	204	1560	250
Hardness, as CaCO ₃	mg/L	1700	NA	1000	1300	2700	4900	6700	1500	400
Total Alkalinity	mg/L	53	NA	880	370	300	1300	710	1900	3200
Total Dissolved Solids	mg/L	3200	NA	2000	3100	2900	4400 J	21000 J	5700	12000
Total Organic Carbon	mg/L	12 J	NA	39 J	33 J	49 J	19 J	7 J	98 J	57 J
Total Solids (Residue)	mg/L	7800 J	7700	2100	3800	3800	7400 J	25000 J	7800	12000

TABLE 3.8
SUMMARY OF GROUNDWATER SAMPLING RESULTS
NON-REGULATED CONSTITUENTS

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-9 CMSMW-9 24-Aug-99 Water Field Sample A9H260105003 13-Sep-99	CMSMW-10 CMSMW-10 24-Aug-99 Water Field Sample A9H260105005 13-Sep-99	CMSMW-11 CMSMW-11 24-Aug-99 Water Field Sample A9H260105006 13-Sep-99	CMSMW-12 CMSMW-12 25-Aug-99 Water Field Sample A9H270119001 13-Sep-99	CMSMW-13S CMSMW-13S 23-Aug-99 Water Field Sample A9H250128008 13-Sep-99	CMSMW-13F CMSMW-13F 23-Aug-99 Water Field Sample A9H250128007 13-Sep-99	CMSMW-14S CMSMW-14S 25-Aug-99 Water Field Sample A9H270119002 13-Sep-99	CMSMW-39S CMSMW-39S 25-Aug-99 Water Field Sample A9H270119003 13-Sep-99	CMSMW-15 CMSMW-15 19-Aug-99 Water Field Sample A9H210120005 16-Sep-99
Analyte										
Non-Regulated Compounds										
Calcium	mg/L	938	612	340	73.1	46.5	187	550	551	1630
Chemical Oxygen Demand (COD)	mg/L	2000	169	276	844	910	206	97.4	101	373
Hardness, as CaCO ₃	mg/L	2900	1800	1400	590	250	1000	1700	1800	4300
Total Alkalinity	mg/L	1100	2500	5400	4200	2200	820	560	530	200
Total Dissolved Solids	mg/L	5000	4600	16000	11000	7900 J	5000 J	2900	3000	740
Total Organic Carbon	mg/L	47 J	65 J	100 J	87 J	110 J	26 J	24 J	23 J	16 J
Total Solids (Residue)	mg/L	7200	5200	22000	11000	8100 J	5300 J	4400 J	3100 J	1400

TABLE 3.8
SUMMARY OF GROUNDWATER SAMPLING RESULTS
NON-REGULATED CONSTITUENTS

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-16F CMSMW-16F 24-Aug-99 Water Field Sample A9H260105007 13-Sep-99	CMSMW-18 CMSMW-18 24-Aug-99 Water Field Sample A9H260105004 13-Sep-99	RFIMW-1 RFIMW-1 19-Aug-99 Water Field Sample A9H210120006 16-Sep-99	RFIMW-4 RFIMW-4 20-Aug-99 Water Field Sample A9H240148004 16-Sep-99	RFIMW-5 RFIMW-5 20-Aug-99 Water Field Sample A9H240148005 16-Sep-99	RFIMW-30 RFIMW-30 20-Aug-99 Water Field Sample A9H240148006 16-Sep-99	RFIMW-6 RFIMW-6 23-Aug-99 Water Field Sample A9H250128003 13-Sep-99	RFIMW-6 DUP RFIMW-6 DUP 23-Aug-99 Water Field Sample A9H250128003X 31-Aug-99	RFIMW-7 RFIMW-7 23-Aug-99 Water Field Sample A9H250128006 13-Sep-99
Analyte										
Non-Regulated Compounds										
Calcium	mg/L	117	1020	573	463	3330	3290	640	NA	881
Chemical Oxygen Demand (COD)	mg/L	2500	1600	261	84.8	69.9	71.5	30	NA	118
Hardness, as CaCO ₃	mg/L	450	3100	2200	1400	8400	8500	1500	NA	2300
Total Alkalinity	mg/L	910	2400	630	700	880 J	79 J	540	NA	1100
Total Dissolved Solids	mg/L	5600	4500	30000	4100	15000	15000	3000 J	2900	13000 J
Total Organic Carbon	mg/L	300 J	38 J	23 J	10 J	6 J	8 J	7	NA	7 J
Total Solids (Residue)	mg/L	6000	6200	31000 J	--	--	16000	2900 J	2900	13000 J

TABLE 3.8
SUMMARY OF GROUNDWATER SAMPLING RESULTS
NON-REGULATED CONSTITUENTS

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		RFIMW-13 RFIMW-13 19-Aug-99 Water Field Sample A9H210120008 16-Sep-99	RFIMW-14 RFIMW-14 20-Aug-99 Water Field Sample A9H240148002 16-Sep-99	RFIMW-14 DUP RFIMW-14 DUP 20-Aug-99 Water Field Sample A9H240148002X 27-Aug-99	RFIMW-39 RFIMW-39 20-Aug-99 Water Field Sample A9H240148003 16-Sep-99	RFIMW-22 RFIMW-22 19-Aug-99 Water Field Sample A9H210120004 16-Sep-99	RFIMW-23 RFIMW-23 19-Aug-99 Water Field Sample A9H210120002 16-Sep-99	RFIMW-23 DUP RFIMW-23 DUP 19-Aug-99 Water Field Sample A9H210120002X 24-Sep-99	RFIMW-29 RFIMW-29 23-Aug-99 Water Field Sample A9H250128001 13-Sep-99	PM4NA PM4NA 23-Aug-99 Water Field Sample A9H250128002 13-Sep-99
Analyte										
Non-Regulated Compounds										
Calcium	mg/L	482	2040	NA	1850	103	271	NA	556	108
Chemical Oxygen Demand (COD)	mg/L	61.4	117	NA	100	300	64.4	NA	53.3	1470
Hardness, as CaCO ₃	mg/L	2000	7000	NA	6800	340	790	NA	1100	1000
Total Alkalinity	mg/L	620	700	NA	730	6200	150	NA	430	8600
Total Dissolved Solids	mg/L	31000	77000	NA	76000	15000	3200	NA	7300 J	43000 J
Total Organic Carbon	mg/L	160 J	7 J	NA	7 J	740 J	10 J	NA	5 J	360 J
Total Solids (Residue)	mg/L	30000 J	77000	77000	78000	--	--	3200	7800 J	42000 J

TABLE 3.9
AIR SAMPLING RESULTS

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BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		BASF-1-1 BASF-1-1 12-Aug-99 Air Field Sample H9H160123 22-Aug-99	BASF-1-2 BASF-1-2 13-Aug-99 Air Field Sample H9H160124 30-Aug-99	BASF-1-3 BASF-1-3 16-Aug-99 Air Field Sample H9H170116 30-Aug-99	BASF-2-1 BASF-2-1 12-Aug-99 Air Field Sample H9H160123 22-Aug-99	BASF-2-2 BASF-2-2 13-Aug-99 Air Field Sample H9H160124 30-Aug-99	BASF-2-3 BASF-2-3 16-Aug-99 Air Field Sample H9H170116 30-Aug-99	BASF-3-1 BASF-3-1 12-Aug-99 Air Field Sample H9H160123 22-Aug-99
Analyte								
1,2,4-Trimethylbenzene	ppb(v/v)	--	--	--	0.71	--	--	--
1,4-Dichlorobenzene	ppb(v/v)	--	--	--	--	--	--	--
4-Methyl-2-pentanone (MIBK)	ppb(v/v)	--	--	--	3.5 J	--	--	--
Acrolein	ppb(v/v)	--	--	--	1.8	--	--	--
Benzene	ppb(v/v)	--	--	--	--	--	--	--
Carbon tetrachloride	ppb(v/v)	--	--	--	--	--	--	--
Dichlorodifluoromethane	ppb(v/v)	--	--	--	--	--	--	--
m-Xylene & p-Xylene	ppb(v/v)	--	--	--	--	--	--	--
n-Butane	ppb(v/v)	1.4 U*	--	--	4.6 U*	--	--	2 U*
n-Decane	ppb(v/v)	--	--	1.4 U*	5.5	--	--	--
n-Dodecane	ppb(v/v)	0.84 U*	--	1.8 U*	9.7	--	--	1.1 U*
n-Heptane	ppb(v/v)	--	--	--	1.1 J	--	--	--
n-Undecane	ppb(v/v)	0.91 U*	--	2.1 U*	11	--	--	1 U*
Nonane	ppb(v/v)	--	--	--	1.6	--	--	--
Pentane	ppb(v/v)	--	--	--	--	--	--	--
Tetrachloroethene	ppb(v/v)	--	--	--	--	--	--	--
Toluene	ppb(v/v)	--	--	--	--	--	--	--
Trichloroethene	ppb(v/v)	--	--	--	--	--	--	--

TABLE 3.9
AIR SAMPLING RESULTS

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		BASF-3-2 BASF-3-2 13-Aug-99 Air Field Sample H9H160124 30-Aug-99	BASF-3-3 BASF-3-3 16-Aug-99 Air Field Sample H9H170116 30-Aug-99	BASF-4-3 BASF-4-3 16-Aug-99 Air Field Sample H9H170116 30-Aug-99	BASF-AMBIENT AMBIENT 12-Aug-99 Air Field Sample H9H160123 22-Aug-99	BASF-CARRIER AIR CARRIER AIR 13-Aug-99 Air H9H160124 30-Aug-99	BASF-TRIP BLANK TRIP BLANK 16-Aug-99 Air H9H170116 30-Aug-99
Analyte							
1,2,4-Trimethylbenzene	ppb(v/v)	--	--	--	--	--	--
1,4-Dichlorobenzene	ppb(v/v)	--	0.94	--	--	--	--
4-Methyl-2-pentanone (MIBK)	ppb(v/v)	--	2.3	--	--	--	--
Acrolein	ppb(v/v)	--	--	--	--	--	--
Benzene	ppb(v/v)	--	--	--	0.62	--	--
Carbon tetrachloride	ppb(v/v)	--	--	1.2	--	--	--
Dichlorodifluoromethane	ppb(v/v)	--	--	--	0.62	--	--
m-Xylene & p-Xylene	ppb(v/v)	--	--	--	0.79	--	--
n-Butane	ppb(v/v)	--	--	--	2.5 J	--	--
n-Decane	ppb(v/v)	--	--	--	--	0.88 J	--
n-Dodecane	ppb(v/v)	--	--	--	--	0.61 J	--
n-Heptane	ppb(v/v)	--	--	--	--	--	--
n-Undecane	ppb(v/v)	--	--	--	--	1.4 J	--
Nonane	ppb(v/v)	--	--	--	--	--	--
Pentane	ppb(v/v)	--	--	--	1.8	--	--
Tetrachloroethene	ppb(v/v)	--	--	1.9	--	--	--
Toluene	ppb(v/v)	--	--	--	1.8	--	--
Trichloroethene	ppb(v/v)	--	--	3.6	--	--	--

**TABLE 3.10
FLUX CHAMBER DATA**

**BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN**

Sample ID Sample Date Measured bypass rate lpm Chamber Pressure in w.c. Total Sweep rate lpm			BASF-1-1 12-Aug-99 0.267 1.0 11.5	BASF-1-2 13-Aug-99 0.972 0.2 9.7	BASF-1-3 16-Aug-99 0.213 0.2 2.4	Location 1 Average NA NA	BASF-2-1 12-Aug-99 0.29 1.1 11.5	BASF-2-2 13-Aug-99 0.958 0.3 11.5	BASF-2-3 16-Aug-99 0.897 0.6 6.9
MW	Analyte								
114	1,2-Dichloropropane	Concentration, (ppbv) Flux, (mg/cm ² -hr)	<i>0.83</i> <i>2.07E-3</i>	<i>0.67</i> <i>1.41E-3</i>	<i>0.69</i> <i>359. E-6</i>	<i>1.28 E-3</i>	<i>0.66</i> <i>1.65E-3</i> 0.71 <i>1.4E-3</i>	<i>0.67</i> <i>1.67E-3</i>	<i>0.7</i> <i>1.05E-3</i>
84	1,2,4-Trimethylbenzene	Concentration, (ppbv) Flux, (mg/cm ² -hr)							
148	1,4-Dichlobenzene	Concentration, (ppbv) Flux, (mg/cm ² -hr)							
102	4-Methyl-2-Pentanone (MIBK)	Concentration, (ppbv) Flux, (mg/cm ² -hr)					3.5 7.82E-3 1.8 000E+0		
	Acrolein	Concentration, (ppbv) Flux, (mg/cm ² -hr)							
78	Benzene	Concentration, (ppbv) Flux, (mg/cm ² -hr)							
150	Carbon Tetrachloride	Concentration, (ppbv) Flux, (mg/cm ² -hr)							
132	Dichlorodifluoromethane	Concentration, (ppbv) Flux, (mg/cm ² -hr)							
106	m- & p-xylene	Concentration, (ppbv) Flux, (mg/cm ² -hr)							
58	n-butane	Concentration, (ppbv) Flux, (mg/cm ² -hr)	<i>1.4</i> <i>1.78E-3</i>				<i>4.6</i> <i>5.84E-3</i> 5.5 <i>18.8E-3</i> 9.7 <i>39.2E-3</i> 1.1 <i>2.41E-3</i> 11 <i>37.6E-3</i> 1.6 <i>4.48E-3</i>		
144	n-Decane	Concentration, (ppbv) Flux, (mg/cm ² -hr)			<i>1.4</i> <i>921. E-6</i>				
170	n-Dodecane	Concentration, (ppbv) Flux, (mg/cm ² -hr)	<i>0.84</i> <i>3.13E-3</i>		<i>1.8</i> <i>1.40E-3</i>				
100	n-Heptane	Concentration, (ppbv) Flux, (mg/cm ² -hr)							
156	n-Undecane	Concentration, (ppbv) Flux, (mg/cm ² -hr)	<i>0.91</i> <i>3.11E-3</i>		<i>2.1</i> <i>1.50E-3</i>				
128	Nonane	Concentration, (ppbv) Flux, (mg/cm ² -hr)							
72	Pentane	Concentration, (ppbv) Flux, (mg/cm ² -hr)							
156	Tetrachloroethene	Concentration, (ppbv) Flux, (mg/cm ² -hr)							
92	Toluene	Concentration, (ppbv) Flux, (mg/cm ² -hr)							
133	Trichloroethene	Concentration, (ppbv) Flux, (mg/cm ² -hr)							

Note: Italicized numbers represent detection limits

TABLE 3.10
FLUX CHAMBER DATA

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BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

Sample ID Sample Date Measured bypass rate lpm Chamber Pressure in w.c. Total Sweep rate lpm			Location 2 Average	BASF-3-1 12-Aug-99	BASF-3-2 13-Aug-99	BASF-3-3 16-Aug-99	Location 3 Average	BASF-4-1 16-Aug-99	BASF-AMBIENT 12-Aug-99
			NA	0.348	1.017	0.884	NA	0.169	0
			NA	1.1	0.4	0.2	NA	0.2	
			NA	11.5	10.8	6.9	NA	5.2	
MW	Analyte								
114	1,2-Dichloropropane	Concentration, (ppbv)		<i>0.71</i>	<i>0.69</i>	<i>0.67</i>		<i>0.74</i>	<i>0.57</i>
		Flux, (mg/cm ² -hr)	<i>1.46 E-3</i>	<i>1.77E-3</i>	<i>1.62E-3</i>	<i>1.00E-3</i>	<i>1.46 E-3</i>	<i>835. E-6</i>	
84	1,2,4-Trimethylbenzene	Concentration, (ppbv)							
		Flux, (mg/cm ² -hr)							
148	1,4-Dichlorobenzene	Concentration, (ppbv)				0.94			
		Flux, (mg/cm ² -hr)				1.83E-3			
102	4-Methyl-2-Pentanone (MIBK)	Concentration, (ppbv)				2.3			
		Flux, (mg/cm ² -hr)				3.08E-3			
	Acrolein	Concentration, (ppbv)							
		Flux, (mg/cm ² -hr)							
78	Benzene	Concentration, (ppbv)							0.62
		Flux, (mg/cm ² -hr)							
150	Carbon Tetrachloride	Concentration, (ppbv)						1.2	
		Flux, (mg/cm ² -hr)						1.78E-3	
132	Dichlorodifluoromethane	Concentration, (ppbv)							0.62
		Flux, (mg/cm ² -hr)							
106	m- & p-xylene	Concentration, (ppbv)							0.79
		Flux, (mg/cm ² -hr)							
58	n-butane	Concentration, (ppbv)		2					2.5
		Flux, (mg/cm ² -hr)		2.54E-3					
144	n-Decane	Concentration, (ppbv)							
		Flux, (mg/cm ² -hr)							
170	n-Dodecane	Concentration, (ppbv)		1.1					
		Flux, (mg/cm ² -hr)		4.09E-3					
100	n-Heptane	Concentration, (ppbv)							
		Flux, (mg/cm ² -hr)							
156	n-Undecane	Concentration, (ppbv)		1					
		Flux, (mg/cm ² -hr)		3.42E-3					
128	Nonane	Concentration, (ppbv)							
		Flux, (mg/cm ² -hr)							
72	Pentane	Concentration, (ppbv)							1.8
		Flux, (mg/cm ² -hr)							
156	Tetrachloroethene	Concentration, (ppbv)						1.9	
		Flux, (mg/cm ² -hr)						2.93E-3	
92	Toluene	Concentration, (ppbv)							1.8
		Flux, (mg/cm ² -hr)							
133	Trichloroethene	Concentration, (ppbv)						3.6	
		Flux, (mg/cm ² -hr)						4.74E-3	

Note: Italicized numbers represent detection limits

**TABLE 3.10
FLUX CHAMBER DATA**

**BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN**

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Sample ID Sample Date Measured bypass rate lpm Chamber Pressure in w.c. Total Sweep rate lpm			BASF-CARRIER AIR 13-Aug-99 0	BASF-TRIP BLANK 16-Aug-99 0
MW	Analyte			
114	1,2-Dichloropropane	Concentration, (ppbv) Flux, (mg/cm ² -hr)	0.56	0.2
84	1,2,4-Trimethylbenzene	Concentration, (ppbv) Flux, (mg/cm ² -hr)		
148	1,4-Dichlobenzene	Concentration, (ppbv) Flux, (mg/cm ² -hr)		
102	4-Methyl-2-Pentanone (MIBK)	Concentration, (ppbv) Flux, (mg/cm ² -hr)		
	Acrolein	Concentration, (ppbv) Flux, (mg/cm ² -hr)		
78	Benzene	Concentration, (ppbv) Flux, (mg/cm ² -hr)		
150	Carbon Tetrachloride	Concentration, (ppbv) Flux, (mg/cm ² -hr)		
132	Dichlorodifluoromethane	Concentration, (ppbv) Flux, (mg/cm ² -hr)		
106	m- & p-xylene	Concentration, (ppbv) Flux, (mg/cm ² -hr)		
58	n-butane	Concentration, (ppbv) Flux, (mg/cm ² -hr)		
144	n-Decane	Concentration, (ppbv) Flux, (mg/cm ² -hr)	0.88	
170	n-Dodecane	Concentration, (ppbv) Flux, (mg/cm ² -hr)	0.61	
100	n-Heptane	Concentration, (ppbv) Flux, (mg/cm ² -hr)		
156	n-Undecane	Concentration, (ppbv) Flux, (mg/cm ² -hr)	1.4	
128	Nonane	Concentration, (ppbv) Flux, (mg/cm ² -hr)		
72	Pentane	Concentration, (ppbv) Flux, (mg/cm ² -hr)		
156	Tetrachloroethene	Concentration, (ppbv) Flux, (mg/cm ² -hr)		
92	Toluene	Concentration, (ppbv) Flux, (mg/cm ² -hr)		
133	Trichloroethene	Concentration, (ppbv) Flux, (mg/cm ² -hr)		

Note: Italicized numbers represent detection limits

TABLE 3.11
GLOSSARY OF DATA VALIDATION QUALIFIERS

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

- U The analyte was not detected at or above the associated numerical value.
- U* This analyte should be considered "not detected" since it was detected in a blank at a similar level.
- J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
- R Unusable results; analyte may or may not be present in this sample.
- UJ This analyte was not detected, but the reporting limit is probably higher due to a low bias identified during the quality assurance review.
- UR Unusable "not-detected" result; analyte may or may not be present in this sample.
- N This result should be considered a tentative qualitative identification.
- This analyte was not detected.

FIGURE 3.1
RFIMW-23 AND CMSMW-01

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

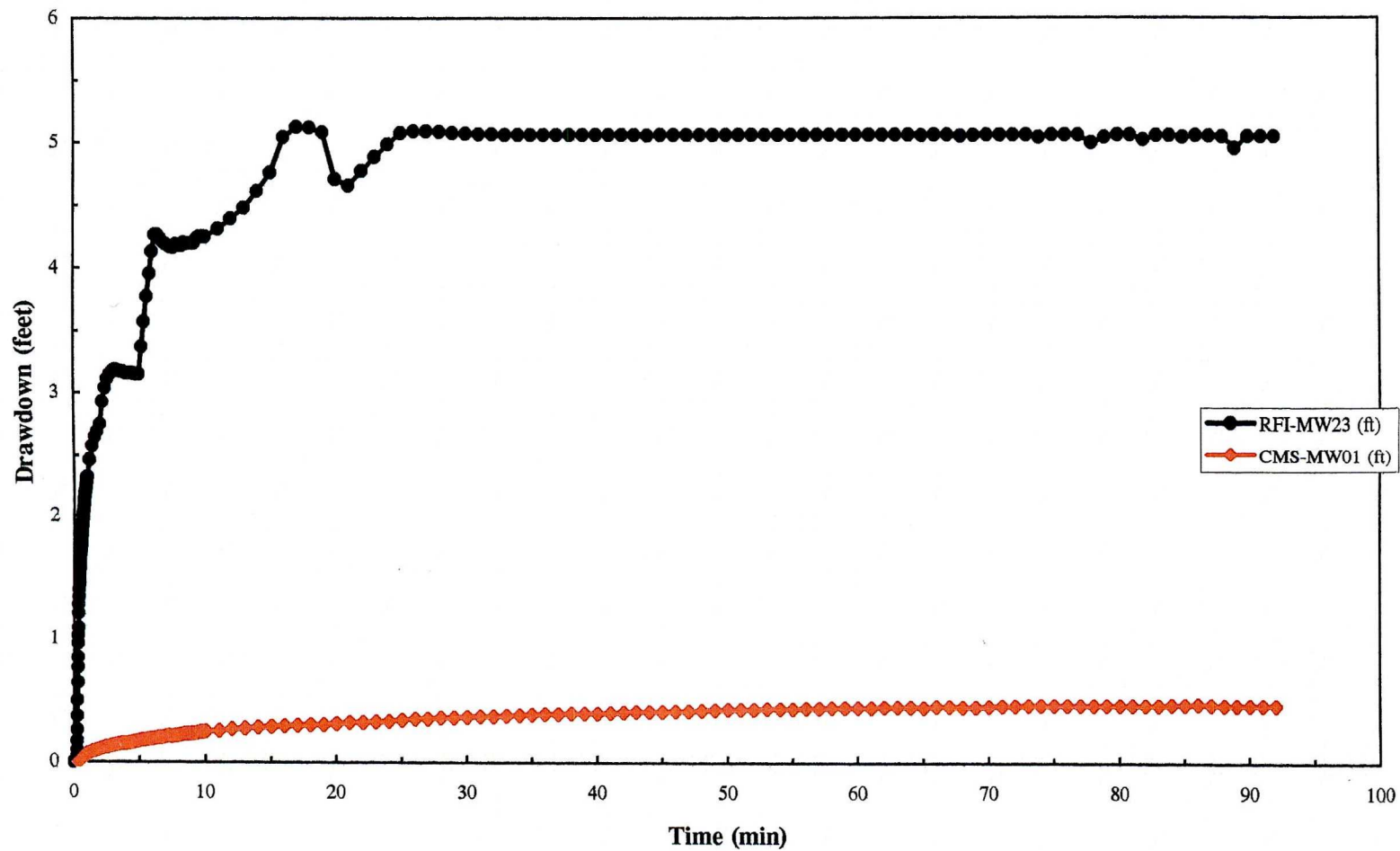


FIGURE 3.2
RFIMW-22 AND CMSMW-02

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

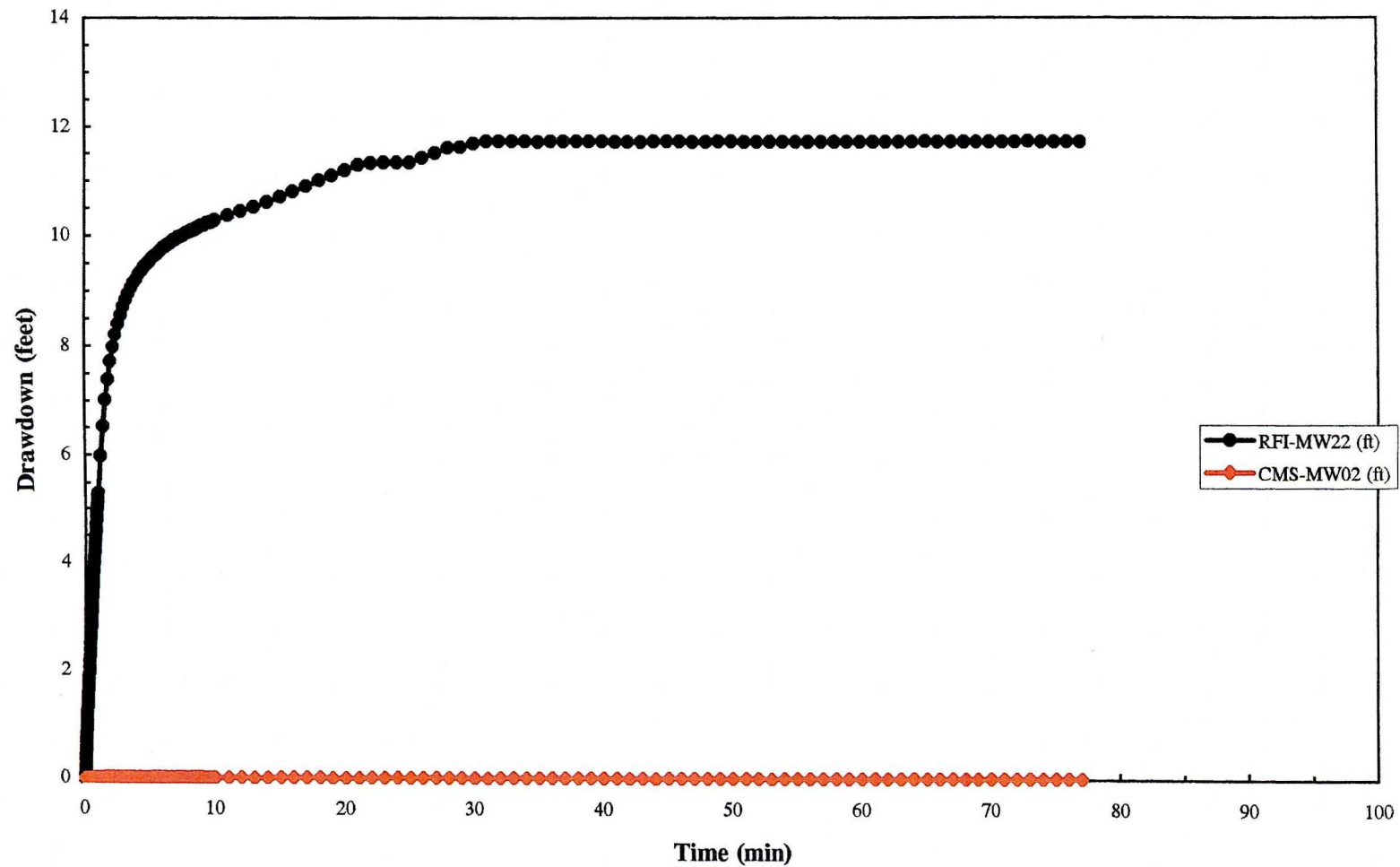


FIGURE 3.3
RFIMW-01 AND CMSMW-15

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

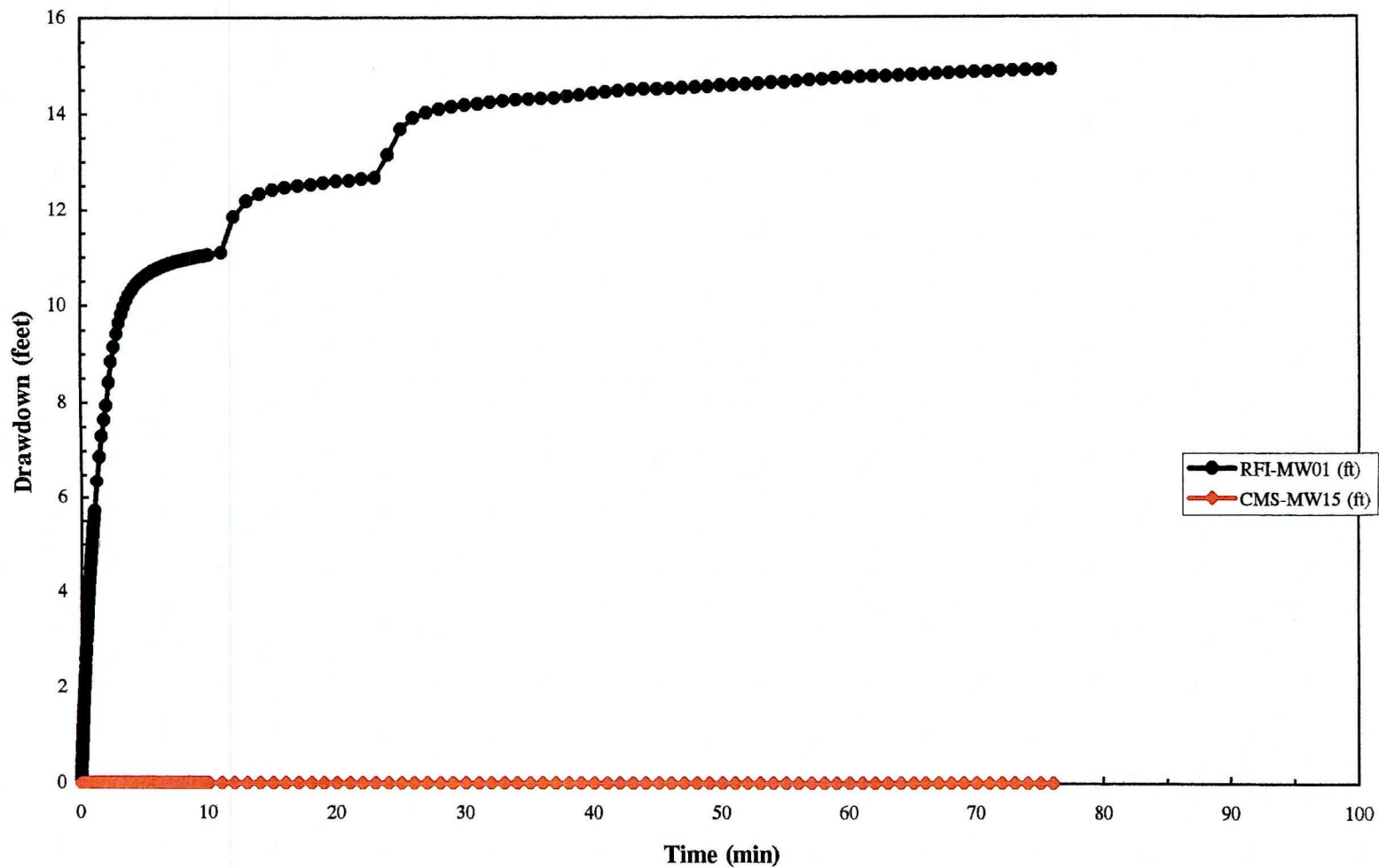


FIGURE 3.4
RFIMW-13 AND CMSMW-03

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

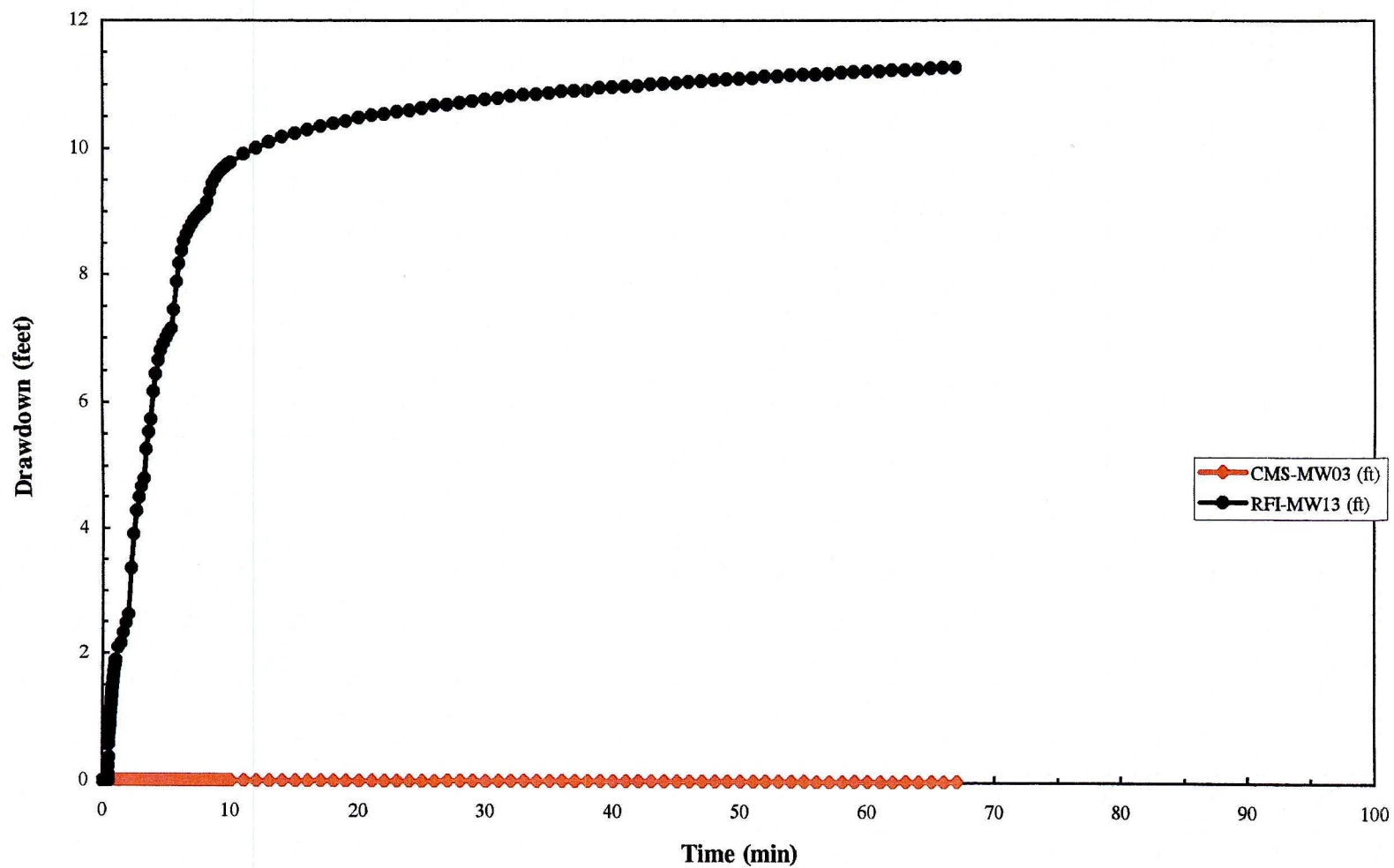


FIGURE 3.5
RFIMW-14F AND CMSMW-04

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

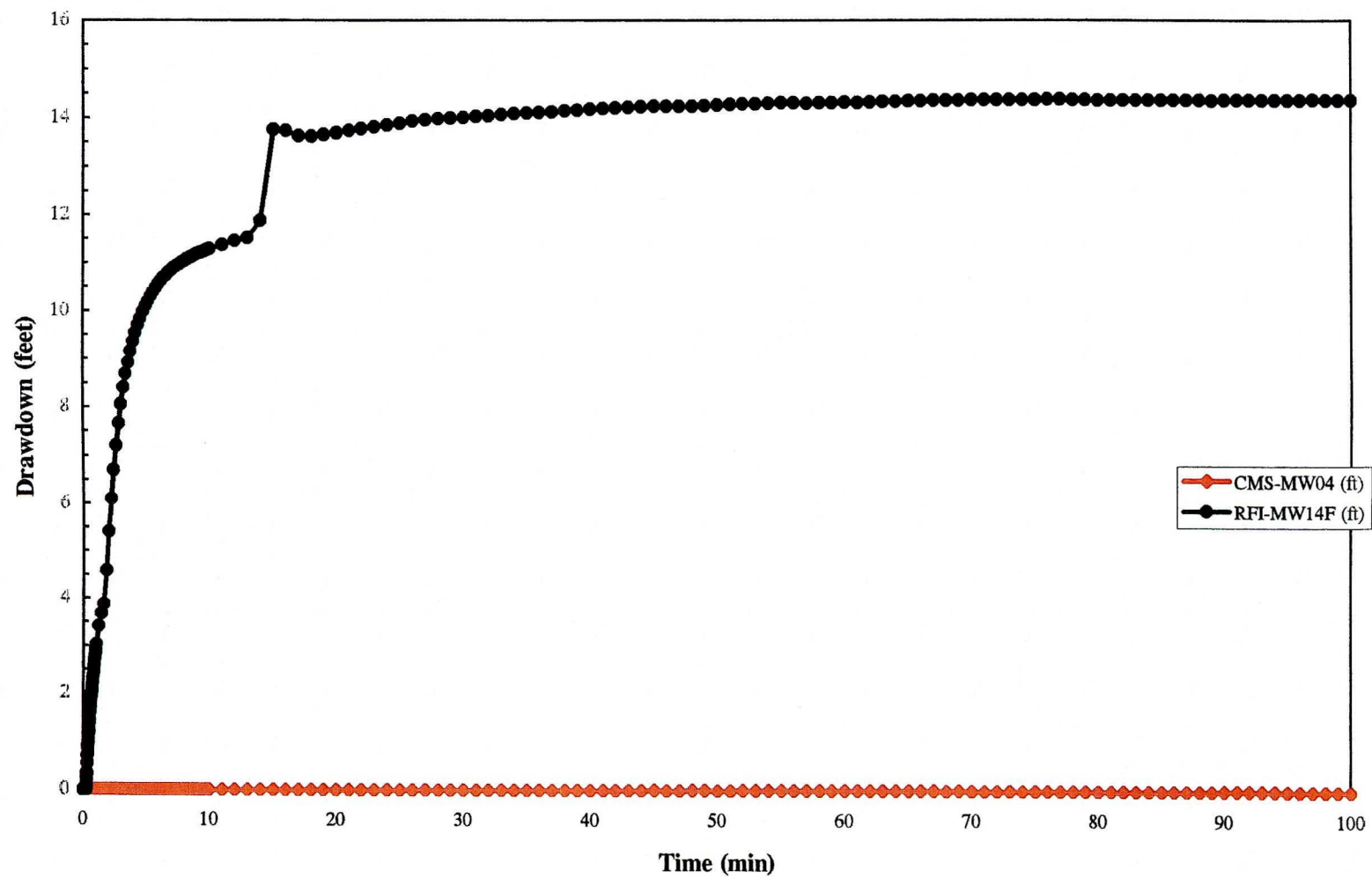
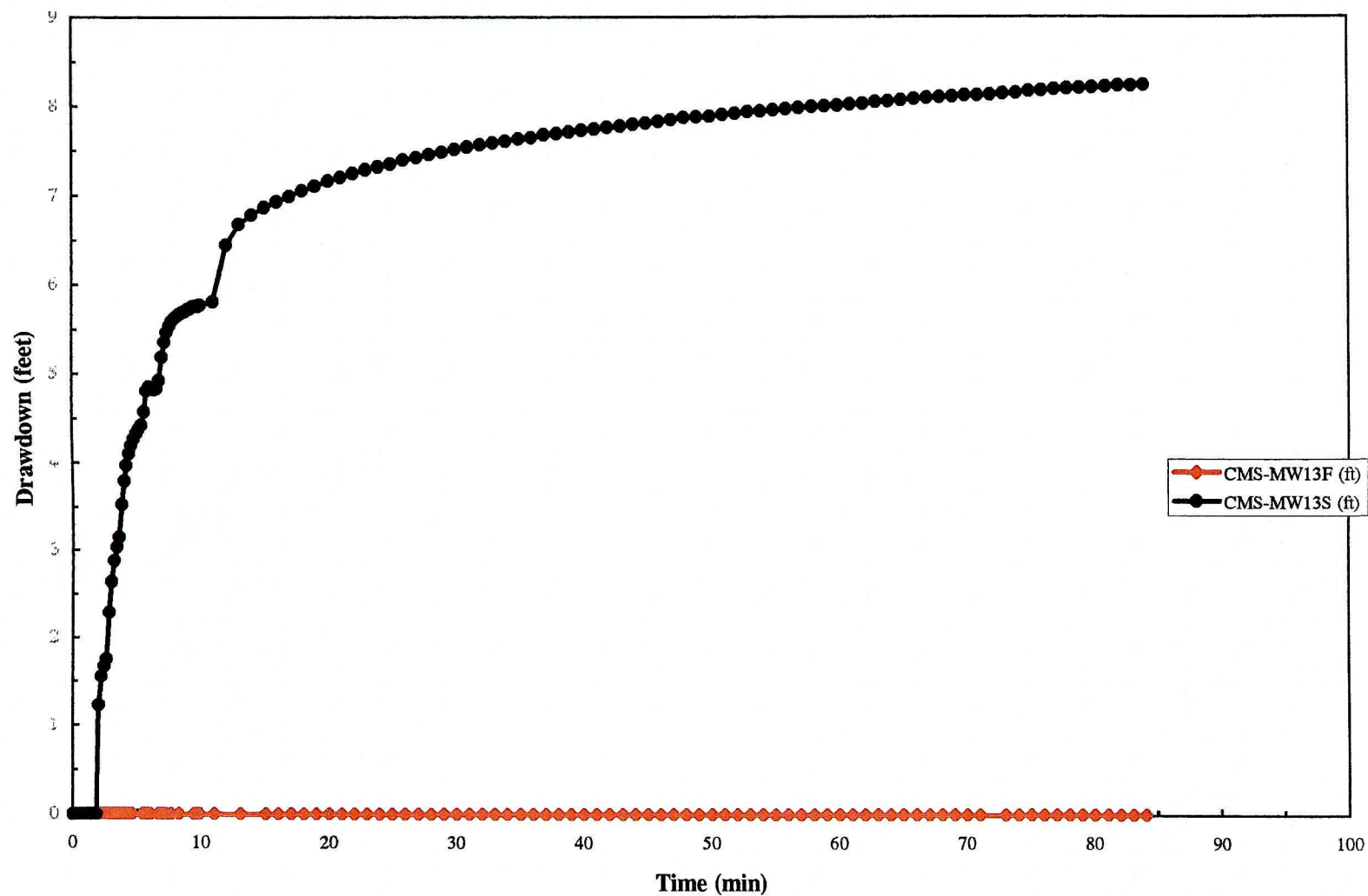
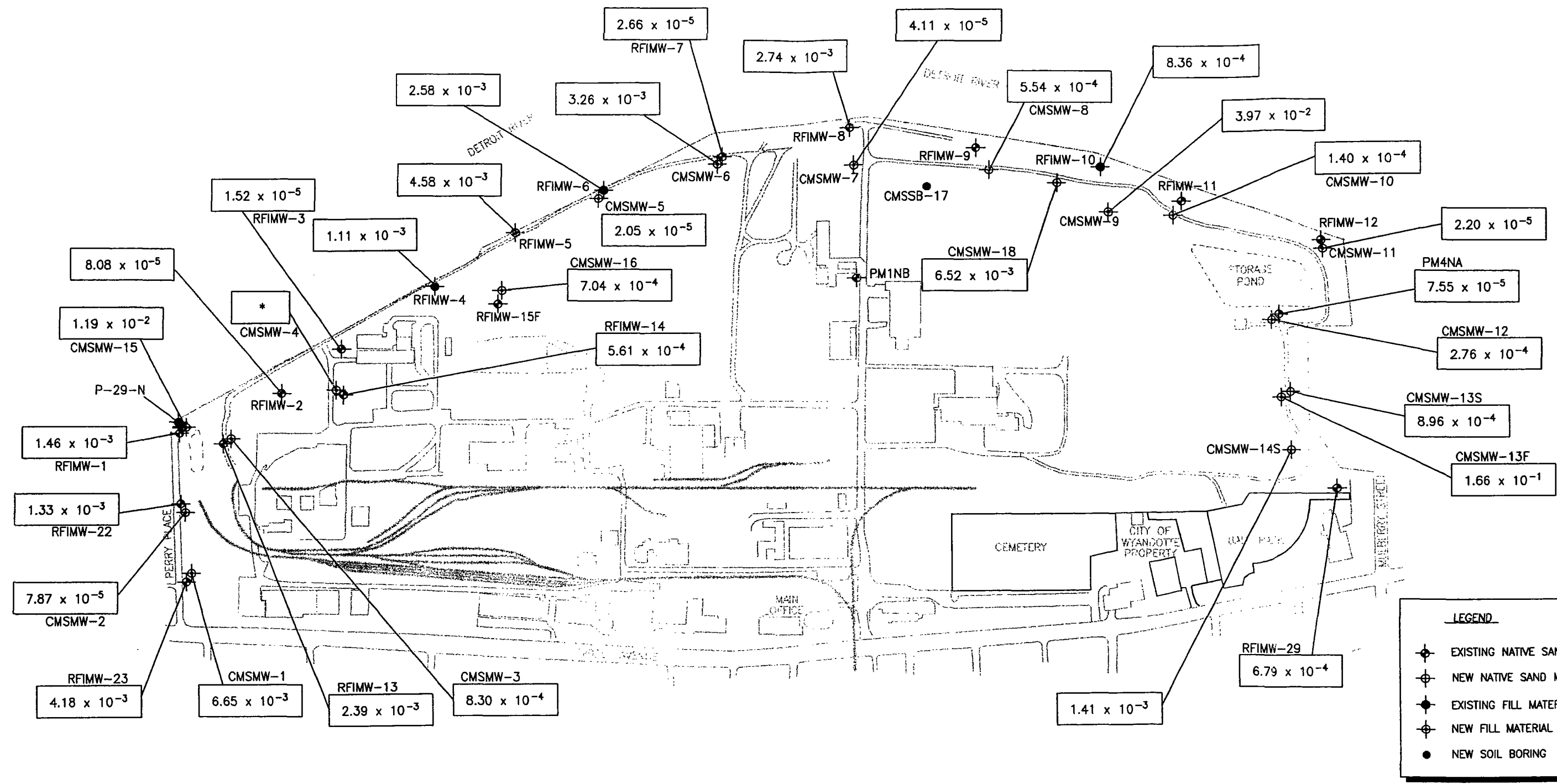


FIGURE 3.6
CMSMW-13F and CMSMW-13S

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN





NOTE: ALL HYDRAULIC CONDUCTIVITY VALUES ARE IN CM/SEC. THE HYDRAULIC CONDUCTIVITY VALUES CORRESPOND TO THE "REPRESENTATIVE HYDRAULIC CONDUCTIVITY" VALUES ON TABLE 3.1.

* WELL CMSMW-4 RECOVERED WITHIN SECONDS AND IS THEREFORE TOO PERMEABLE TO QUANTIFY CONDUCTIVITY USING SLUG TESTING METHODS.

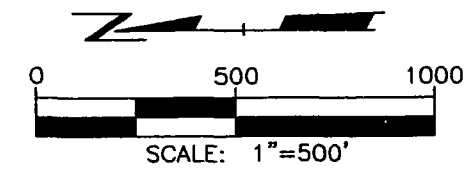
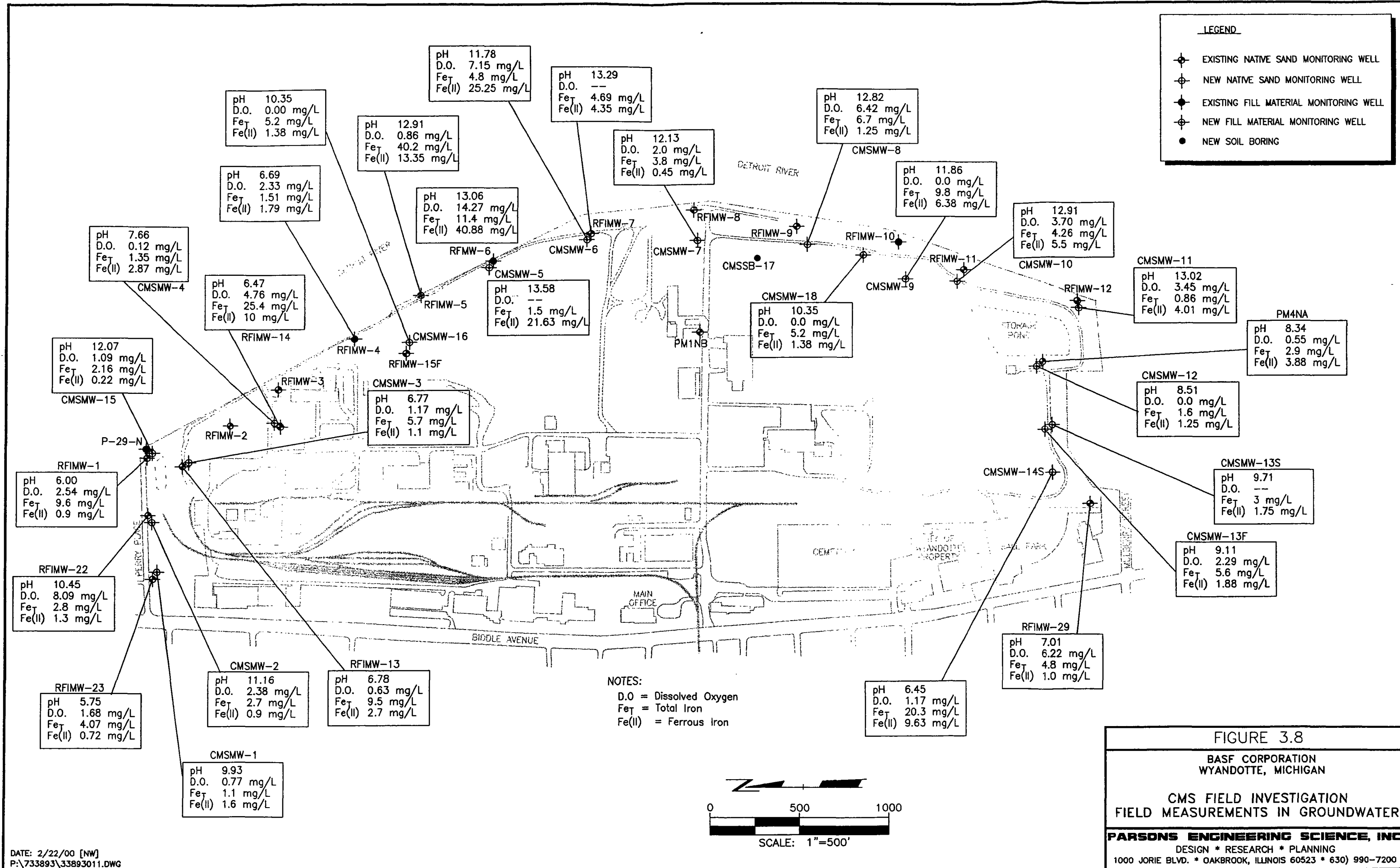


FIGURE 3.7


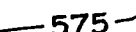
BASF CORPORATION
WYANDOTTE, MICHIGAN

CMS FIELD INVESTIGATION
SLUG TEST RESULTS

PARSONS ENGINEERING SCIENCE, INC.
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LEGEND

-  FILL MATERIAL MONITORING WELL
-  575 GROUNDWATER CONTOUR (IN FT.)

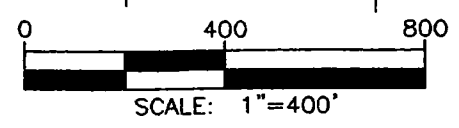
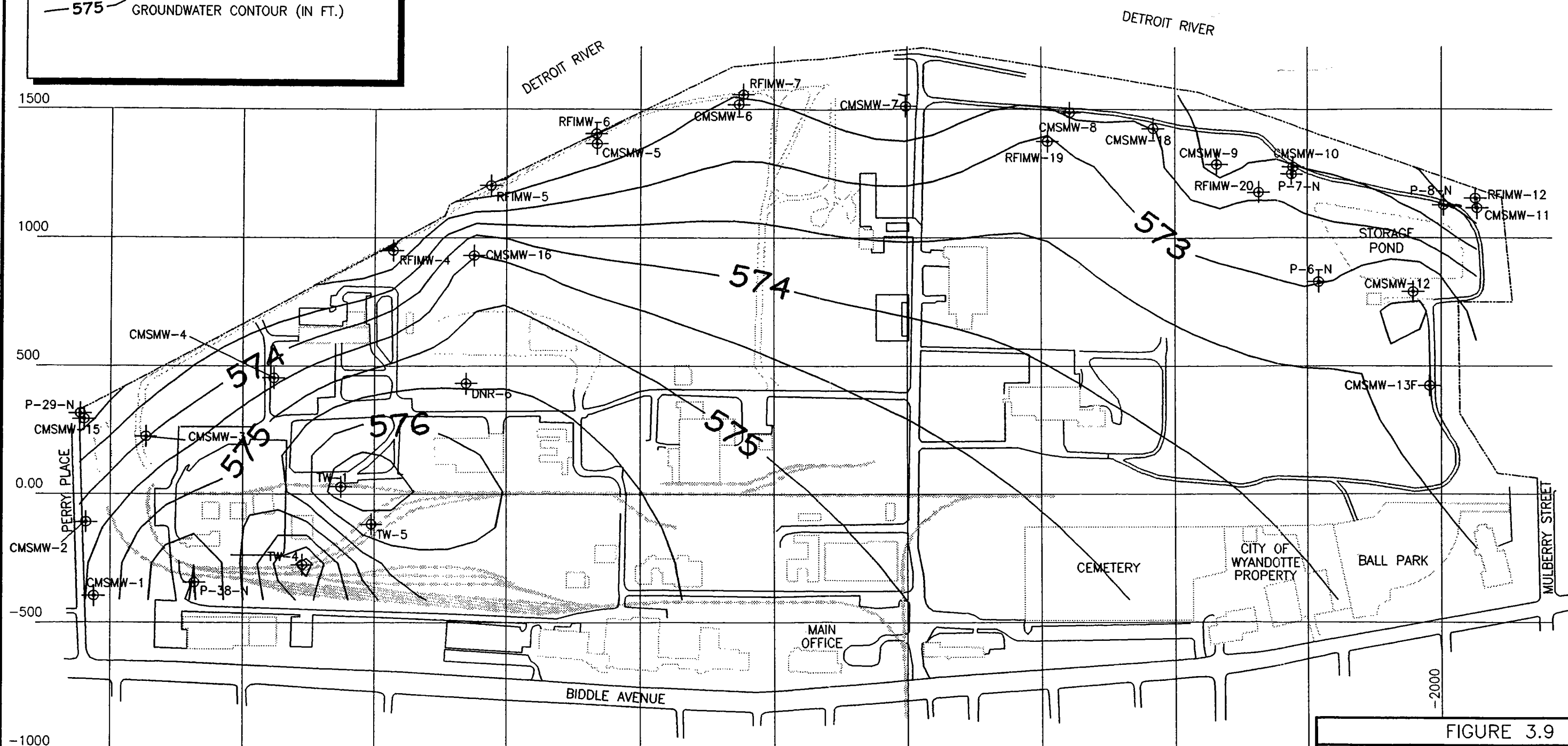


FIGURE 3.9

BASF CORPORATION
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 CMS FIELD INVESTIGATION
 GROUNDWATER CONTOUR MAP
 FILL UNIT

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DATE: 3/20/00 [nw]
 R:\DRAWINGS\BASF\33893015A.DWG

LEGEND

- EXISTING NATIVE SAND MONITORING WELL
- NEW NATIVE SAND MONITORING WELL
- EXISTING FILL MATERIAL MONITORING WELL
- NEW FILL MATERIAL MONITORING WELL
- NEW SOIL BORING

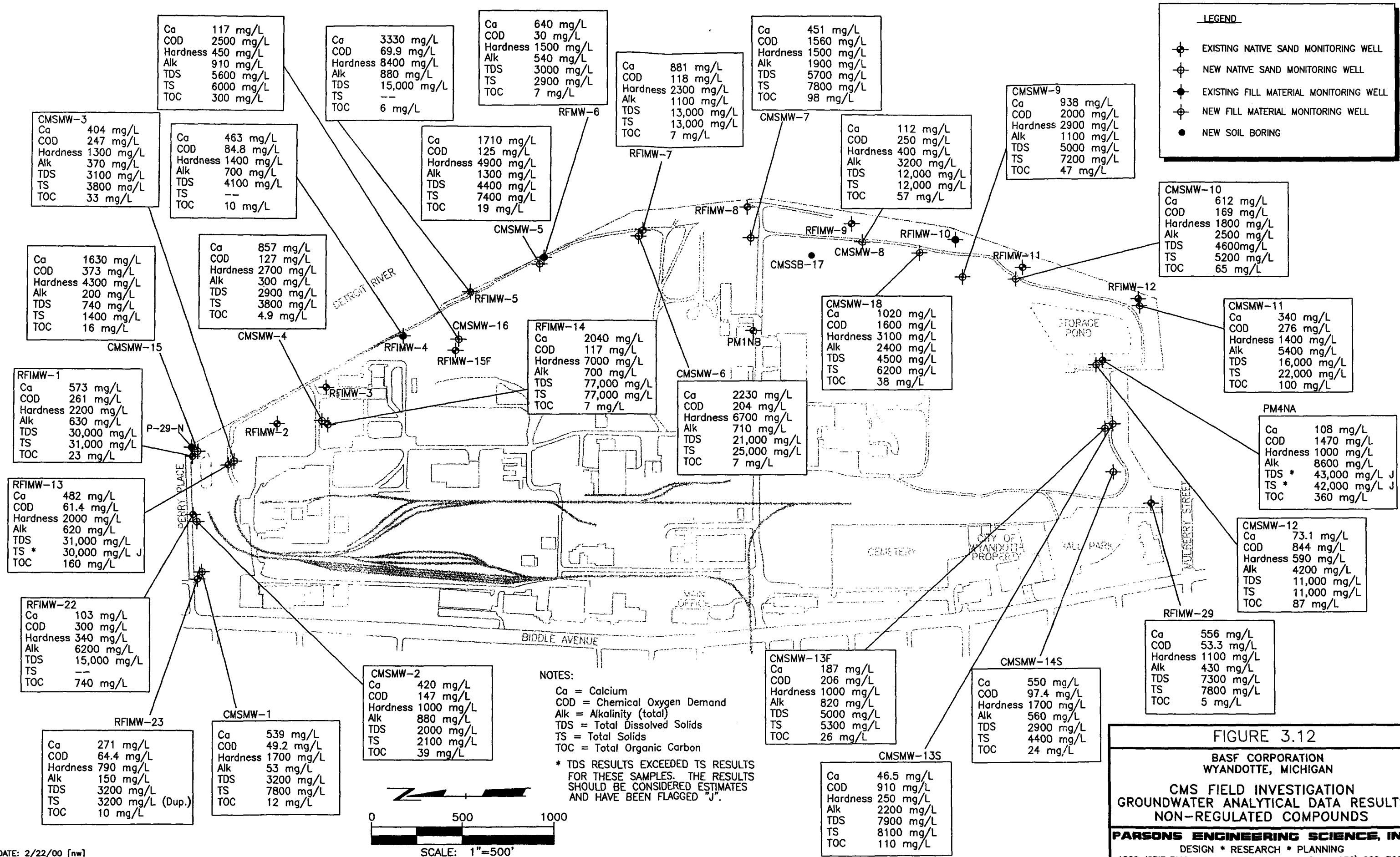


FIGURE 3.12

BASF CORPORATION
WYANDOTTE, MICHIGAN

CMS FIELD INVESTIGATION
GROUNDWATER ANALYTICAL DATA RESULTS
NON-REGULATED COMPOUNDS

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SECTION 4

DATA EVALUATION AND INTERPRETATION

4.1 OVERVIEW

This section presents a detailed analysis of the findings of the investigation and the data that were presented in Section 3. The analysis is presented under the following major categories:

- Subsurface Soil/Fill Assessment - includes discussion on the geophysical surveys and the soil borings data pertaining to soil geology.
- Groundwater Assessment - includes a discussion on the aquifer pumping tests and slug tests.
- SWMU H Risk Evaluation Assessment – explains the implication of the mass flux field and air analytical data results relative to the inhalation risks posed by the SWMU H area.
- Laboratory Data Validation Assessment – provides reference to the Environmental Standards, Inc. validation report.

4.2 SUBSURFACE SOIL/FILL ASSESSMENT

4.2.1 Geophysical Survey Assessment

Geosphere, Inc. of Midland, Michigan performed the geophysical surveys of the Facility. The maps generated during the EM surveys are presented as Figures 4.1, 4.2, 4.3, and 4.4. The complete geophysical report is contained in Appendix A. The “historical maps” referenced in this section are Figures 2-1 through 2-5 of the RCRA Facility Investigation Report of Current Conditions (1998).

4.2.1.1 EM INTERPRETATION

North Area (Area A) (from Gridline 1460N to Gridline 1800N)

Information taken from historical maps indicate that a drainage ditch passed through the North Area in somewhat of a zigzag pattern from a point west of Wyandotte Road to the Detroit River. A linear feature with notably high conductivity was observed in the river area oriented in a southwest to northeast direction (Figures 4.1 and 4.2). Because of the straightness of this feature and its high conductivity level, this feature is interpreted as a buried culvert probably composed of steel or iron rebar in concrete. Subtle patterns in both EM38 and EM31 maps suggest that the filled

ditch lies some 20 to 30 feet south of the outline taken from old maps. The eastern portion of this feature coincides with the culvert feature, suggesting that the culvert may have been laid in the eastern part of the ditch.

Central and South Area (Areas B, C, D, E, and F)

Ditch outlines from the old maps show that a main east-west ditch ran from Area B through Area C to the river. Just east of Wyandotte Road, a northern feeder ditch joined the Main Ditch. South of the Main Ditch was another east-west ditch (called Ditch B, Ditch C and Ditch D in various segments along its path), which turned south for 900 feet before it turned back to the east to the river.

Linear trends of lower conductivity correlate very closely with ditch patterns taken from the old maps (Figure 4.3 and 4.4). This correlation is indisputable in survey Areas B and C for both the Main Ditch and Ditch B and C segments. It also appears that a short ditch may have interconnected the two east-west ditches immediately west of Wyandotte Road. A similar interconnecting ditch is found at the eastern end of the two ditches near gridline 1300E.

The route of Ditch D is not obvious, but crucial features are recognizable and the interpretation from the old maps appears accurate. A linear, north-south trend in EM values is also observed that may have been a temporary ditch that connected Ditches C and D. Ditch D eventually turns to the east toward the river.

Consistently high values are attributable to the alkali plant that once stood in this area; strong negative EM31 values and very high EM38 values over this segment of the ditch are representative of extensive pilings and steel reinforced concrete pilings. Farther to the east at the interpreted old breakwater, the conductivity features may represent concrete pilings or old wharves. Linear east-west features are interpreted as a series of concrete pilings that likely supported the former alkali plant and ancillary buildings.

The feature labeled as the 1919 Ditch (Figures 4.3 and 4.4) correlates to a linear trend of high conductivity values, unlike all the other ditch/channel features. This linear pattern is unusual in that

it was only found on the 1919 map, whereas all other ditches/channels were located on two or more maps of the area.

Low conductivity patterns in Area E correlate closely with the old shipyard channel which is some 80 to 90 feet wide. The northeastern portion of this channel merges with the interpreted old river breakwater/wharf area described above.

High conductivity values are again found in Area F. A prominent linear pattern of very high values runs through the southeastern corner of Area F, oriented in a southwest to northeast direction. It appears to lie in an approximate parallel relationship with an old road that extended to the firewater pump house. It may represent a pattern of high-salt fill dumped from the road or a buried utility. The outline of the South End shipyard channel is not as clearly evident in the geophysical maps as the other ditches/channels, but certain crucial lows and interpreted (negative) pilings line up with the shape and size of the old map outlines.

4.2.1.2 Seismic Assessment

Five lines of seismic refraction were performed in areas where the clay ridge was thought to be present (Figure 4.5). Information from the seismic lines (in conjunction with the EM data) indicates that subsurface conditions in the central part of the eastern study area are not indicative of a simple system of Native Sand overlying clay. The clay ridge has very likely been cut and shaped by ditch/channel excavations and by numerous foundations/pilings of the former alkali plant that once stood in this area. These foundations appear to be widespread and probably are in contact with or occupy a sizeable portion of the original clay ridge surface. The interpreted seismographs are presented in Figures 4.6, 4.7, 4.8, 4.9, and 4.10.

4.2.2 Soil Boring Assessment

To supplement the existing subsurface data from wells installed previously, a variety of methods were utilized during the CMS field investigation to evaluate the nature and distribution of subsurface materials. The CMS field investigation also sought to more accurately define the locations and approximate dimensions of buried erosional features (former drainage ditches) known to have existed on the underlying lacustrine clay material. Geophysical surveys were performed to

confirm the presence and locations of these features. Nineteen borings were drilled and sampled to reinforce the findings of the geophysical surveys. Soil samples were collected in each boring on a continuous basis to further define the physical characteristics and extent of the subsurface fill and underlying natural materials. All of the CMS soil borings, with the exception of CMSSB-17, were converted to monitoring wells. The location of the wells and boring are shown in Figure 4.11.

Assessment of the physical characteristics and extent of various subsurface materials was accomplished through detailed sample descriptions, and by submitting representative samples of the various materials for grain size analysis. Data from the soil boring logs (Appendix B) and grain size analyses results (Appendix F) were used to construct the Facility geology discussion presented below.

4.2.2.1 Facility Geology

The nature of the materials beneath the Facility consists of a wide variety of both natural and anthropogenic (fill) materials. These materials have a wide variety of characteristics and distribution patterns. The subsurface materials have been categorized into five primary units :

1. A sandy fill, consisting primarily of sand size or finer materials mixed with urban/industrial fill. This material typically is present from the ground surface to between 2 and 7.5 feet below grade.
2. An urban or industrial fill unit, consisting primarily of two types of material:
 - Concrete rubble.
 - A material in boring logs described as a 'soft putty' material, (possibly DBO) which directly underlies the sandy fill, except in borings CMSMW-2, CMSMW-3, CMSMW-5, CMSMW13, and CMSMW-14.
3. The Native Sand Unit containing some gravel.
4. A natural peat and organic clay.
5. A natural (lacustrine) silty clay, which underlies the above listed units across the entire area of investigation.

Geologic cross-sections based on the information generated from the CMS field program and the spatial survey information are presented as Figures 4.12 through 4.15.

The peat occurs at depths ranging between 10 and 20 feet below grade and ranges in thickness between less than 0.5 feet and 2 feet. The peat was encountered in all of the soil borings except CMSMW-1, CMSMW-2, CMSMW-3, CMSMW-13S, and CMSMW-14S.

The Native Sand Unit does not occur consistently across the Facility, but it was found directly beneath the fill in borings CMSMW-13S and CMSMW-14S. This unit is characterized by well sorted fine to medium sand. The sand is loose with a random presence of gravel.

The base lacustrine clay unit was encountered in all soil borings except CMSMW-2, CMSMW-3, and CMSMW-4, which were terminated in the upper fill layers. The depth to the clay unit varies between 8 feet (CMSMW-8) and 20 feet below grade (CMSMW-9 and CMSMW-6). Deeper borings from previous investigations and regional information indicate the lacustrine clay unit exists to depths of 70 feet or more below grade and overlies limestone or dolomite bedrock. This clay unit appears to underlie the entire study area, and is typically a hard, relatively impermeable clay. Possible exceptions are in CMSMW-10 (boring depth 12 feet) and CMSMW-11 (boring depth 18 feet) where, based on grain size analysis, this unit is identified as a clayey silt. It is within this clay unit that features, such as the shipyard channel and other drainage ditches, appear to have been incised.

4.2.2.2 Former Drainage Ditches

An additional goal of the CMS was to confirm the existence and location of the buried channels and trenches noted on the historical topographic surface of the Facility. Soil borings were placed in the areas identified by the geophysical surveys as being a potential former drainage channel or the shipping channel outlet that could provide a conduit off-site. Soil borings CMSMW-09 and CMSMW-13S were targeted to fall within the former shipyard channel and the southern drainage channel, respectively. A topographically low area on the clay unit surface is present at CMSMW-09, and likely corresponds to the area where the former shipyard channel existed. A similar topographic low at CMSMW-11 may represent the edge of an old shoreline. Another topographically low area on the lacustrine clay surface is found at the southern edge of the Facility (CMSMW-13S). This topographical change may represent features associated with the

buried trench identified as the "South End Channel" in the geophysical survey report (Figures 4.3 and 4.4, Appendix A).

Boring CMSMW-16 was placed in the area suspected as the buried topographical feature identified in EM Survey Area A as an "east-west trending ditch". Boring CMSMW-18 was placed in the area suspected as the buried topographical feature identified in the EM Survey Area E as the east-west trending ditch north of the former shipping channel. Based on cross-section B-B' (Figure 4.13) and on the CMSMW-16 and CMSMW-18 soil boring logs, the location of these ditches are not readily apparent.

A discussion on the hydrogeology of the former drainage ditch areas in comparison to the areas located outside of the drainage ditches is included in Section 4.3.4.

4.3 GROUNDWATER DATA ASSESSMENT

4.3.1 Groundwater Monitoring Well Installation

Groundwater monitoring wells were installed in all of the soil borings, except CMSSB-17. Groundwater monitoring wells CMSMW-13S and CMSMW-14S were screened in the Native Sand Unit. All of the remaining groundwater monitoring wells were screened in the fill unit. The well installation information is summarized in Table 4.1, and the soil boring/well installation logs are presented in Appendix B.

4.3.2 Groundwater Contour Maps and Discussion

One groundwater surface map was constructed for the fill wells and a separate map for the Native Sand wells. The water table for groundwater in the fill is shown on Figure 3.9. The potentiometric surface for groundwater in the Native Sand Unit is shown as Figure 3.10. The pumping tests illustrated that the fill and Native Sand Units are not hydraulically connected (refer to discussions in Subsection 4.3.3), and the groundwater surface maps could not be drawn using water levels in both sets of wells.

The flow direction of the groundwater in the fill material (depicted on Figure 3.9) shows the groundwater flowing in a general easterly direction toward the Detroit River. In the northern one-third of the Facility the groundwater is flowing in a north-easterly direction, and in the remainder of

the Facility there is a southerly component to the groundwater flow direction. The apparent groundwater divide shown running approximately through monitoring wells CMSMW-16 and RFIMW-5 could be attributed to the presence of the DBO material present south and east of these two wells. The pattern of the contour lines in the vicinity of these wells most likely indicate the flow of the groundwater around the DBO fill material, which is known to have a relatively low permeability.

The groundwater flow in the Native Sand Unit (depicted on Figure 3.10) closely mimics the groundwater flow in the fill unit, although for different reasons. The peat layer that separates the Native Sand Unit and the fill unit is not continuous across the western portion of the north end of the Facility. The absence of the clay unit allows the Native Sand Unit and the fill unit to be in better communication with each other; hence the similarity in groundwater flow directions.

In the Native Sand Unit, the groundwater flow south of the apparent groundwater divide in the vicinity of monitoring wells CMSMW-5 and RFIMW-6, is toward the south (Figure 3.10). This flow pattern is attributable to two separate subsurface characteristics: the groundwater extraction system operating in the south-central portion of the Facility, and the clay ridge which runs along the eastern portion of the Facility. The groundwater extraction system is responsible for the shallow depression noted in the south-central area of the Facility, where the groundwater along the southern edge of the Facility is shown to be flowing north toward the extraction system. This indicates that in the Native Sand Unit, the existing groundwater extraction system is preventing groundwater from leaving the site at the southern edge.

✓ The truncation of the groundwater contour lines in the eastern portion of the Facility is attributed to the Native Sand Unit pinching out along the western edge of the clay ridge and the presence of the overlying peat unit. As noted during performance of the pumping tests, the fill unit and the Native Sand Unit appear to be hydraulically disconnected. The isolation of the Native Sand Unit from the fill material coupled with the groundwater surface elevations measured in the Native Sand wells indicates that the Native Sand Unit is, at a minimum, semi-confined and groundwater is under some pressure. Although the groundwater elevations measured in the wells screened in the Native Sand Unit are above the elevation of the clay ridge, the overlying peat unit serves as the

upper boundary of the actual groundwater surface. The peat layer covers the Native Sand Unit and the western leg of the clay ridge and prevents (or greatly limits) groundwater in the Native Sand Unit from flowing east, over the clay ridge, and into the Detroit River. Therefore, as illustrated on Figure 3.10, the groundwater flow lines terminate at the approximate location of the western edge of the Native Sand Unit where the peat unit lies directly over the clay ridge.

4.3.3 Pumping Test Data Discussion

The aquifer pumping test results are summarized in Figures 3.1 through 3.6 and in Table 4.2. These figures show that, in general, water levels in the shallow fill layer did not respond to prolonged pumping from the deeper Native Sand Unit. The discontinuities seen in the graphs presented in Figures 3.1 through 3.6 correspond to the point in time when adjustments were made to the pumping rate. The results observed at each nested well pair are discussed in more detail below. It is noted that the assessment of "low vertical hydraulic conductivity" referred to in the following sections is based on the lack of response observed in the wells screened in the fill unit while pumping from the wells screened in the Native Sand Unit.

4.3.3.1 Well Cluster CMSMW-1 AND RFIMW-23

The results from the pumping test performed at well cluster CMSMW-1 and RFIMW-23 are shown in Figure 3.1. These curves show that when creating approximately 5 feet of drawdown in the Native Sand well, there was approximately 0.45 feet of drawdown observed in the corresponding fill well and, therefore, some groundwater flowed between the two units in this area of the Facility. A review of the soil boring logs associated with these wells found no peat layer in the vicinity of these wells.

4.3.3.2 Well Cluster CMSMW-2 and RFIMW-22

The results from the pumping test performed at well cluster CMSMW-2 and RFIMW-22 are shown in Figure 3.2. These curves show that even when creating approximately 11 feet of drawdown in the Native Sand well, there was no drawdown observed in the corresponding fill well and, therefore, there is no flow between the two units. A review of the soil boring logs associated with these wells found no peat layer in the vicinity of these wells. The limited hydraulic

communication between the two nested wells can be attributed to the low vertical hydraulic conductivity of the fill unit and/or the silt layer separating the fill unit from the Native Sand Unit.

4.3.3.3 Well Cluster CMSMW-15 and RFIMW-1

The results from the pumping test performed at well cluster CMSMW-15 and RFIMW-1 are shown in Figure 3.3. These curves show that even when creating over 14 feet of drawdown in the Native Sand well, there was no drawdown observed in the corresponding fill well and, therefore, there is no flow between the two units. A review of the soil boring logs from these wells shows a 2-foot thick peat layer in the vicinity of these wells. The limited hydraulic communication between the two nested wells can be attributed to (1) the presence of the peat layer, (2) the low vertical hydraulic conductivity of the fill unit, or (3) both of these factors.

4.3.3.4 Well Cluster CMSMW-3 and RFIMW-13

The results from the pumping test performed at well cluster CMSMW-3 and RFIMW-13 are shown in Figure 3.4. These curves show that even when creating over 11 feet of drawdown in the Native Sand well, there was no drawdown observed in the corresponding fill well and, therefore, no groundwater flow between the two units. A review of the soil boring logs associated with these wells found no peat layer in the vicinity of these wells. Given the absence of any distinct impermeable layer, the limited hydraulic communication between the two nested wells is attributed to the low vertical hydraulic conductivity of the fill unit.

4.3.3.5 Well Cluster CMSMW-4 and RFIMW-14

The results from the pumping test performed at well cluster CMSMW-4 and RFIMW-14 are shown in Figure 3.5. These curves show that even when creating over 14 feet of drawdown in the Native Sand well, there was no drawdown observed in the corresponding fill well and, therefore, there is no flow between the two units at this location. A review of the soil boring logs from these wells found 1 foot of peat in the vicinity of these wells. The limited hydraulic communication between the two nested wells can either be attributed to (1) the presence of the peat layer, (2) the low vertical hydraulic conductivity of the fill unit, or (3) both of these factors.

4.3.3.6 Well Cluster CMSMW-13F and CMSW-13S

The results from the pumping test performed at well cluster CMSMW-13F and CMSMW-13S are shown in Figure 3.6. These curves show that even when creating over 8 feet of drawdown in the Native Sand well, there was no drawdown observed in the corresponding fill well and, therefore, there is no flow between the two units. A review of the soil boring logs associated with these wells found no peat layer in the vicinity of these wells. Given the absence of any distinct impermeable layer, the limited hydraulic communication between the two nested wells is attributed to the low vertical hydraulic conductivity of the fill unit.

4.3.3.7 Summary of Well Cluster Pumping Testing

In general, since there was no drawdown observed in the fill layer during pumping from the Native Sand layer, groundwater does not appear to flow between the two units. This strongly suggests that the fill and Native Sand layers are not hydraulically connected over most of the Facility. The only exception occurred at nested well pair RFIMW-23 and CMSMW-1. While pumping from the Native Sand well, approximately 0.5 feet of drawdown was observed in the shallow fill well, suggesting that the two stratigraphic units may be hydraulically connected in the northwest corner of the Facility.

4.3.3.8 Implications of the Findings of the Well Cluster Pumping Test

As stated previously in Subsection 4.3.3.7, the assessment of the aquifer pumping test data from the CMS field program indicates that there is either limited or no hydraulic response in the fill unit when groundwater is pumped from the Native Sand Unit. It is likely, therefore, that the same result would be obtained if groundwater is pumped from the fill unit (i.e., no response would be noted in the Native Sand Unit). After reviewing the soil boring logs and the Facility's lithological information, this limited hydraulic communication between the two units can primarily be attributed to the low vertical hydraulic conductivity of the fill material and/or the presence of a peat layer at selected subsurface areas of the Facility.

Given the limited hydraulic communication between the fill and Native Sand Units, it is likely that any groundwater containment/extraction alternative will need to address groundwater in each stratigraphic unit separately.

4.3.4 Slug Test Discussion

The results of the slug tests are summarized in Table 3.1 and graphically displayed in Figure 3.7. The horizontal hydraulic conductivity values measured at the Facility ranged from 1.52×10^{-5} to 1.66×10^{-1} cm/sec. The geometric mean hydraulic conductivity in the fill unit is approximately 1×10^{-3} cm/sec, while the geometric mean of hydraulic conductivity in the Native Sand Unit is approximately 7×10^{-4} cm/sec. In general, the results indicate that the areas near the southern and northern property boundaries of the Facility and along the eastern shoreline are moderately to highly permeable.

Monitoring wells CMSMW-09, CMSMW-13S, CMSMW-16, and CMSMW-18 were placed at locations along the eastern property boundary believed to be former drainage ditch and/or shipyard channels. A comparison of the hydraulic conductivity values for each of these four wells to the other fill wells, shows that CMSMW-09 has a slightly higher conductivity value (3.97×10^{-2} cm/sec) than the other fill wells placed along the eastern property boundary (2.05×10^{-5} to 3.97×10^{-2} cm/sec), potentially indicative of ditch channel fill materials. The hydraulic conductivity values obtained in monitoring wells CMSMW-16 and CMSMW-18 (7.04×10^{-4} and 6.52×10^{-3} cm/sec, respectively) are not dissimilar from the hydraulic conductivity values for the other wells along the eastern boundary that are screened in the fill unit. Therefore, as discussed in Section 2.3.2, the subsurface materials and hydraulic conditions encountered in CMSMW-16 and CMSMW-18 neither confirm nor refute the presence of former drainage ditch channels.

Monitoring well CMSMW-13S was placed in an area believed to contain the former southern drainage ditch channel. By itself, the lithology of the subsurface materials encountered in the CMSMW-13S boring are inconclusive with regard to the existence of the former drainage ditch. However, as illustrated in geologic cross-section C-C' (Figure 4.14), there is more fill material present at the CMSMW-13 location compared to the CMSMW-14S location. It is possible that fill

material noted at CMSMW-13S (Figure 4.14) is associated with the bottom of a former drainage ditch. Wells CMSMW-14S and CMSMW-12 are located too far apart from the CMSMW-13 nested well location to provide any indicator information relative to the ditch channel boundaries in this area. Nevertheless, the relatively high hydraulic conductivity value (1.66×10^{-1} cm/sec) obtained in CMSMW-13F (which is set in fill material) could be an indicator that the CMSMW-13S/CMSMW-13F nested well pair is situated in a former drainage channel. CMSMW-13F is the only well with such a high conductivity value; a value that obviously represents more permeable fill.

The southern end of the Facility appears to have less subsurface fill material. As such, any drainage ditch that may have existed in this area would most likely have been shallow in nature, since the depth to groundwater is between 2 and 3 feet below ground surface in the fill wells located along this south-central boundary area.

4.3.5 Groundwater Screening Data Discussion

As described in Section 2.3.6, several common geochemical constituents in groundwater that can impact the effectiveness of a groundwater system were evaluated as part of the CMS. The results are presented in Table 4.3. A discussion of these geochemical results and the implications for groundwater pumping and treatment are presented below.

4.3.5.1 Dissolved Oxygen, Specific Conductivity, Temperature and pH

Dissolved oxygen concentrations were typically very low, indicating that conditions are predominantly reducing and that anaerobic microbial processes may be degrading groundwater constituents. Additionally, as described below, the lack of dissolved oxygen in the groundwater suggests that any iron in the groundwater will be present in the reduced ferrous state.

4.3.5.2 Redox Potential

The redox values measured over most of the Facility were all negative, indicating that the groundwater is in a reduced state. These redox values support the findings of low levels of dissolved oxygen and the presence of ferrous iron.

4.3.5.3 Iron

As described in the previous section, the combination of low dissolved oxygen concentrations, together with negative redox conditions, both indicate that all iron should be present in a reduced state, as soluble ferrous iron. A review of the field data (Table 4.3) shows that this is generally the case. There are, however, selected instances where total iron is underestimated and the ferrous iron results are greater than total iron results.

The anomaly of ferrous iron results exceeding total iron results occurred during the CMS field program although the field analytical protocols for these compounds were executed in accordance with the standard operating procedures specified in the project QAPP. It is noted however, that the results observed at wells CMSMW-5, CMSMW-6, and RFIMW-6 show ferrous iron exceeding total iron by several orders of magnitude (relative to the exceedances noted for the other wells). Since the total iron samples from these three wells were analyzed after the ferrous iron samples, the ferrous iron present in these samples probably was oxidized and precipitated from solution, resulting in the lower total iron measurements. For the purpose of this evaluation, we have assumed the total iron results from these locations are the same as the ferrous iron results. This assumption is consistent with other geochemical measurements (low dissolved iron and negative redox potential values).

Iron concentrations averaged approximately 9 mg/L. High concentrations of ferrous iron present in solution will quickly oxidize in groundwater treatment systems when exposed to the atmosphere, and form a ferric iron precipitate. The levels of dissolved iron found in the Facility's groundwater are high enough to cause a build up of this ferric iron precipitate in pipes, sumps, pumps, and GAC, if not removed prior to treatment.

4.3.5.4 Calcium, Hardness, Alkalinity, and Total Dissolved Solids

Another common problem in remediation projects is precipitation of calcium carbonate in wells, piping, pumps, and treatment equipment. The Langelier saturation index (LI), (Viessman and Hammer [1993]), can predict the tendency of a water to deposit or dissolve calcium carbonate.

The index can be calculated as follows:

$$LI = pH - pH_s = \left[(pK'_2 - pK'_s) + pCa^{2+} + pAlk \right]$$

where:

pH = measured pH in water

pH_s = pH at CaCO₃ saturation (equilibrium)

pK'₂ - pK'_s = constants based on ionic strength and temperature

pCa²⁺ = negative logarithm of calcium ion concentration (moles/L)

pAlk = negative logarithm of the total alkalinity (equivalents/L)

A LI value of zero indicates that the water is stable; negative values indicate a corrosive water; and positive values indicate supersaturation. The LI is only an approximate measure of the water stability of a system. Physical factors such as the velocity and residence time will affect the rate and amount of deposition.

As shown in Table 4.3, the LI was calculated for the Facility monitoring wells using the calcium, alkalinity, pH, temperature, and total dissolved solids data. The indices were positive for every well but two, indicating that the water is oversaturated and will tend to deposit calcium carbonate throughout the treatment system. These deposits, which tend to be very hard (harder than iron precipitates), will require an acid cleaning to remove and will result in increased operation and maintenance costs. This is presently the case with the existing extraction system.

4.3.5.5 Chemical Oxygen Demand and Total Organic Content

Typical COD/TOC ratios expected in groundwater are approximately 3 (Metcalf & Eddy, 1991); the exact relationship is dependent upon the oxidation state of individual carbon species. The ratios of COD to TOC (presented in Table 4.3) found in groundwater, range from 0.38 to 43 with an average of 11. These elevated ratios are probably attributable to elevated CODs due to the presence of reduced inorganic species such as ferrous iron, sulfide, and manganous manganese. As such, the COD cannot be used as an accurate measure of organic content.

4.3.6 Groundwater Analytical Data Discussion

The VOC and SVOC analytical data results were compared to the Michigan Department of Environmental Quality (MDEQ) Groundwater Surface Water Interface (GSI) standards (as defined in MDEQ Part 201 regulations). As shown in Table 4.4, there are ten exceedances of the MDEQ GSI standards for organic compounds: acetone, benzene, vinyl chloride, fluoranthene, naphthalene, phenol, and 1,4-dioxane. These occur at five different wells: CMSMW-13S, CMSMW-13F, RFIMW-1, RFIMW-22, and RFIMW-23. With the exception of RFIMW-22, the values exceed the standards by one order of magnitude or less. At RFIMW-22, acetone, benzene, and vinyl chloride exceed the standards by two orders of magnitude.

4.4 SWMU H RISK EVALUATION ASSESSMENT

The preliminary risk assessment performed during the RFI identified SWMU H as an area of concern. The carcinogenic risks for current maintenance workers, future maintenance, facility and construction/utility workers ranged from 6×10^{-4} to 8×10^{-3} , exceeding the target range of 1×10^{-4} to 1×10^{-6} . Closer inspection of the risk calculations showed that the vapor inhalation of 1,2-dichloropropane accounted for 99 percent of the total potential carcinogenic risk at SWMU H. The individual risk associated with inhaling 1,2-dichloropropane was driven by the analytical results from a single soil sample collected at SWMU H.

The RFI stated that the preliminary risk assessment probably resulted in an over-estimation of potential human health and ecological risks at the facility. Since constituents in the air (dust and vapors) were not measured, constituent concentrations in air could only be estimated using known subsurface soil concentrations and the assumption that 1,2-dichloropropane partitions between the soil and vapor phase according to Henry's Law. This method tends to predict higher concentrations in dust and vapors than would likely occur over time. As a result of this conservative assumption, the RFI recommended that future work should focus on the refinement of these assumed concentrations.

Parsons ES performed a flux chamber analysis at SWMU H to quantify the surface VOC emissions and to evaluate the inhalation exposure pathway. The results of the flux chamber

analysis, summarized in Table 3.8, showed only trace levels of VOCs in the air, and no detectable levels of 1,2-dichloropropane.

Potential human health risks associated with exposure to individual carcinogens can be calculated using the following expression:

$$Risk = I \times CSF$$

where,

I = chronic daily chemical intake averaged over a lifetime of 70 years (mg/kg-day)

CSF = slope factor (6.8×10^{-2} kg-day/mg for 1,2-dichloropropane)

The chronic daily intake can be calculated as follows:

$$I = \frac{(C \times CR \times EF \times ED \times RR \times ABS)}{(BW \times AT)}$$

where,

CR = contact rate ($19.92 \text{ m}^3/\text{day}$ breathing rate for an average adult)

C = concentration at exposure point (mg/m^3)

EF = exposure frequency (365 days/year)

ED = exposure duration (70 years)

BW = body weight (70 kg)

AT = averaging time (70 years for carcinogens)

RR = retention rate (1.0)

ABS = absorption into bloodstream (1.0)

The range of carcinogenic risk values generated during the RFI (6×10^{-4} and 8×10^{-3}) were evaluated using the expressions outlined above. The range of air concentrations that correspond to these levels of risk is approximately 90 to 15,000 ppbv of 1,2-dichloropropane. As mentioned previously, 1,2-dichloropropane was undetected (detection limits ranged between 0.66 and 0.83 ppbv) in all flux emission chamber air samples collected during the CMS field effort. Accordingly, the resultant

risk values will be less than 10^{-6} . Therefore, there is no unacceptable inhalation risk at SWMU H. The inhalation exposure pathway may be eliminated from further consideration as part of the CMS.

4.5 LABORATORY DATA VALIDATION ASSESSMENT

All hard copy analytical data, electronic data deliverables, and associated laboratory backup information generated by Quanterra, Inc. laboratories were submitted by Quanterra, Inc. to Environmental Standards, Inc. (ESI) in Valley Forge, Pennsylvania. The quality assurance review and data assessment of the laboratory-generated groundwater and air data were performed by ESI upon receipt of this information. The soil and groundwater analytical data utilized by Parsons ES and presented in this CMS Field Program Report were provided to Parsons ES in electronic form by ESI (after data validation activities were completed and all data qualifications had been incorporated into the database). The activities performed by ESI as part of the data validation process and the findings from their review are presented in a data validation report entitled *Quality Assurance Review of the BASF RCRA Facility Investigation Samples Collected on August 12 -25, 1999 in Wyandotte, Michigan, November 15, 1999, prepared by Environmental Standards, Inc.* It is noted that the title of the ESI data validation report incorrectly refers to the sampling event as the "RCRA Facility Investigation Samples Collected on August 12 -25". It should have referred to the sampling event as the "RCRA Corrective Measures Study Field Investigation Samples Collected on August 12-25". The abovementioned data validation report is submitted herein along with the CMS Field Program Report, as Appendix G.

TABLE 4.1
MONITORING WELL INSTALLATION INFORMATION
BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

Well Identification	Stratigraphic Unit Monitored	Screen Length (feet)	Screen Bottom Depth (feet)
CMSMW-1	Fill	2	7
CMSMW-2	Fill	5	8.75
CMSMW-3	Fill	2	6.5
CMSMW-4	Fill	7	15
CMSMW-5	Fill	7	15
CMSMW-6	Fill	5	19
CMSMW-7	Fill	2	10
CMSMW-8	Fill	4	10
CMSMW-9	Fill	10	20
CMSMW-10	Fill	5	10
CMSMW-11	Fill	10	16
CMSMW-12	Fill	5	9
CMSMW-13S	Native Sand	7	19
CMSMW-13F	Fill	2	7.5
CMSMW-14	Native Sand	7	13
CMSMW-15	Fill	5	9
CMSMW-16	Fill	5	15
CMSMW-18	Fill	5	14

**TABLE 4.2
PUMPING TEST RESULTS**

**BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN**

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Well Cluster	Pumping Well Drawdown (feet)	Observation Well Drawdown (feet)	Conclusions
CMS-MW01/RFI-MW23	5.05	0.452	Evidence of hydraulic connection between sand and fill units at the northern portion of the facility.
CMS-MW02/RFI-MW22	11.73	0.006	Limited hydraulic communication attributed to low vertical conductivity of the fill unit.
CMS-MW15/RFI-MW01	14.91	0.000	Limited hydraulic communication attributed to either low vertical conductivity of the fill unit or the presence of a peat layer.
CMS-MW03/RFI-MW13	11.25	0.006	Limited hydraulic communication attributed to low vertical conductivity of the fill unit.
CMS-MW04/RFI-MW14F	14.38	0.003	Limited hydraulic communication attributed to either low vertical conductivity of the fill unit or the presence of a peat layer.
CMS-MW13F/CMS-MW13S	8.23	0.000	Limited hydraulic communication attributed to low vertical conductivity of the fill unit.

TABLE 4.3
GROUNDWATER TREATMENT EVALUATION

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-1 CMSMW-1 19-Aug-99 Water Field Sample A9H210120001 16-Sep-99	CMSMW-2 CMSMW-2 19-Aug-99 Water Field Sample A9H210120003 16-Sep-99	CMSMW-3 CMSMW-3 19-Aug-99 Water Field Sample A9H210120007 16-Sep-99	CMSMW-4 CMSMW-4 20-Aug-99 Water Field Sample A9H240148001 16-Sep-99	CMSMW-5 CMSMW-5 23-Aug-99 Water Field Sample A9H250128004 13-Sep-99	CMSMW-6 CMSMW-6 23-Aug-99 Water Field Sample A9H250128005 13-Sep-99
Analyte							
pH	--	9.93	11.16	6.77	7.66	13.58	11.98
Dissolved Oxygen	mg/L	0.77	2.38	1.17	0.12	--	7.15
Temperature	°C	17.6	17.7	20.4	18.2	12.4	12.8
Oxidation Reduction Potential	mV	-85	-358	-40	-99	--	-75
Calcium	mg/L	539	420	404	857	1710	2230
Total Iron	mg/L	1.6 ⁽¹⁾	2.7	5.7	2.87 ⁽¹⁾	21.63 ⁽¹⁾	25.25 ⁽¹⁾
Ferrous Iron	mg/L	1.6	0.9	1.1	2.87	21.63	25.25
Hardness, as CaCO ₃	mg/L	1700	1000	1300	2700	4900	6700
Total Alkalinity	mg/L	53	880	370	300	1300	710
Total Dissolved Solids (TDS)	mg/L	3200	2000	3100	2900	4400 J	21000 J
Total Solids (TS)	mg/L	7800 J	2100	3800	3800	7400 J	25000 J
Chemical Oxygen Demand (COD)	mg/L	49.2	147	247	127	125	204
Total Organic Carbon (TOC)	mg/L	12 J	39 J	33 J	49 J	19 J	7 J
Langelier Index (LI)	--	2.50	4.80	0.14	1.21	7.81	5.97
COD/TOC ratio	--	4.10	3.77	7.48	2.59	6.58	29.14

(1): As discussed in the text, the ferrous iron present in these samples probably was oxidized and precipitated from solution, resulting in the lower total iron measurements. For the purposes of this evaluation, it was assumed that the total iron results from these locations are the same as the ferrous iron results.

TABLE 4.3
GROUNDWATER TREATMENT EVALUATION

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-7 CMSMW-7 24-Aug-99 Water Field Sample A9H260105001 13-Sep-99	CMSMW-8 CMSMW-8 24-Aug-99 Water Field Sample A9H260105002 13-Sep-99	CMSMW-9 CMSMW-9 24-Aug-99 Water Field Sample A9H260105003 13-Sep-99	CMSMW-10 CMSMW-10 24-Aug-99 Water Field Sample A9H260105005 13-Sep-99	CMSMW-11 CMSMW-11 24-Aug-99 Water Field Sample A9H260105006 13-Sep-99	CMSMW-12 CMSMW-12 25-Aug-99 Water Field Sample A9H270119001 13-Sep-99
Analyte							
pH	--	12.13	12.82	11.86	12.91	13.02	8.51
Dissolved Oxygen	mg/L	2	6.42	0	3.7	3.45	0
Temperature	°C	18.6	17.5	14.8	16.6	16.6	17.4
Oxidation Reduction Potential	mV	-80	--	-460	-430	--	--
Calcium	mg/L	451	112	938	612	340	73.1
Total Iron	mg/L	3.8	6.7	9.8	5.5 ⁽¹⁾	4.01 ⁽¹⁾	1.6
Ferrous Iron	mg/L	0.45	1.25	6.38	5.5	4.01	1.25
Hardness, as CaCO ₃	mg/L	1500	400	2900	1800	1400	590
Total Alkalinity	mg/L	1900	3200	1100	2500	5400	4200
Total Dissolved Solids (TDS)	mg/L	5700	12000	5000	4600	16000	11000
Total Solids (TS)	mg/L	7800	12000	7200	5200	22000	11000
Chemical Oxygen Demand (COD)	mg/L	1560	250	2000	169	276	844
Total Organic Carbon (TOC)	mg/L	98 J	57 J	47 J	65 J	100 J	87 J
Langelier Index (LI)	--	6.13	6.36	5.83	7.09	7.30	2.34
COD/TOC ratio	--	15.92	4.39	42.55	2.60	2.76	9.70

(1): As discussed in the text, the ferrous iron present in these samples probably was oxidized and precipitated from solution, resulting in the lower total iron measurements. For the purposes of this evaluation, it was assumed that the total iron results from these locations are the same as the ferrous iron results.

TABLE 4.3
GROUNDWATER TREATMENT EVALUATION

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-13S CMSMW-13S 23-Aug-99 Water Field Sample A9H250128008 13-Sep-99	CMSMW-13F CMSMW-13F 23-Aug-99 Water Field Sample A9H250128007 13-Sep-99	CMSMW-14S CMSMW-14S 25-Aug-99 Water Field Sample A9H270119002 13-Sep-99	CMSMW-15 CMSMW-15 19-Aug-99 Water Field Sample A9H210120005 16-Sep-99	CMSMW-16F CMSMW-16F 24-Aug-99 Water Field Sample A9H260105007 13-Sep-99	CMSMW-18 CMSMW-18 24-Aug-99 Water Field Sample A9H260105004 13-Sep-99
Analyte							
pH	--	9.71	9.11	6.45	12.07	10.35	11.92
Dissolved Oxygen	mg/L	--	2.29	1.17	1.09	0	0.06
Temperature	°C	17.8	21	17.5	17.7	14.4	17
Oxidation Reduction Potential	mV	--	--	--	-100	-420	--
Calcium	mg/L	46.5	187	550	1630	117	1020
Total Iron	mg/L	3	5.6	20.3	2.16	5.2	0.7
Ferrous Iron	mg/L	1.75	1.88	9.63	0.22	1.38	1
Hardness, as CaCO ₃	mg/L	250	1000	1700	4300	450	3100
Total Alkalinity	mg/L	2200	820	560	200	910	2400
Total Dissolved Solids (TDS)	mg/L	7900 J	5000 J	2900	740	5600	4500
Total Solids (TS)	mg/L	8100 J	5300 J	4400 J	1400	6000	6200
Chemical Oxygen Demand (COD)	mg/L	910	206	97.4	373	2500	1600
Total Organic Carbon (TOC)	mg/L	110 J	26 J	24 J	16 J	300 J	38 J
Langelier Index (LI)	--	2.93	2.65	0.06	5.84	3.40	6.34
COD/TOC ratio	--	8.27	7.92	4.06	23.31	8.33	42.11

(1): As discussed in the text, the ferrous iron present in these samples probably was oxidized and precipitated from solution, resulting in the lower total iron measurements. For the purposes of this evaluation, it was assumed that the total iron results from these locations are the same as the ferrous iron results.

TABLE 4.3
GROUNDWATER TREATMENT EVALUATION

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		RFIMW-1 RFIMW-1 19-Aug-99 Water Field Sample A9H210120006 16-Sep-99	RFIMW-4 RFIMW-4 20-Aug-99 Water Field Sample A9H240148004 16-Sep-99	RFIMW-5 RFIMW-5 20-Aug-99 Water Field Sample A9H240148005 16-Sep-99	RFIMW-6 RFIMW-6 23-Aug-99 Water Field Sample A9H250128003 13-Sep-99	RFIMW-7 RFIMW-7 23-Aug-99 Water Field Sample A9H250128006 13-Sep-99	RFIMW-13 RFIMW-13 19-Aug-99 Water Field Sample A9H210120008 16-Sep-99
Analyte							
pH	--	6	6.69	12.91	13.06	13.29	6.78
Dissolved Oxygen	mg/L	2.54	2.33	0.86	14.27	--	0.63
Temperature	°C	12.7	18.2	13	14.9	13.2	14
Oxidation Reduction Potential	mV	-126	-206	-114	48	--	-142
Calcium	mg/L	573	463	3330	640	881	482
Total Iron	mg/L	9.6	1.79 ⁽¹⁾	40.2	40.88 ⁽¹⁾	4.69	9.5
Ferrous Iron	mg/L	0.9	1.79	13.35	40.88	4.35	2.7
Hardness, as CaCO ₃	mg/L	2200	1400	8400	1500	2300	2000
Total Alkalinity	mg/L	630	700	880 J	540	1100	620
Total Dissolved Solids (TDS)	mg/L	30000	4100	15000	3000 J	13000 J	31000
Total Solids (TS)	mg/L	31000 J	--	--	2900 J	13000 J	30000 J
Chemical Oxygen Demand (COD)	mg/L	261	84.8	69.9	30	118	61.4
Total Organic Carbon (TOC)	mg/L	23 J	10 J	6 J	7	7 J	160 J
Langelier Index (LI)	--	-0.48	0.27	7.08	6.53	7.01	0.29
COD/TOC ratio	--	11.35	8.48	11.65	4.29	16.86	0.38

(1): As discussed in the text, the ferrous iron present in these samples probably was oxidized and precipitated from solution, resulting in the lower total iron measurements. For the purposes of this evaluation, it was assumed that the total iron results from these locations are the same as the ferrous iron results.

TABLE 4.3
GROUNDWATER TREATMENT EVALUATION

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		RFIMW-14 RFIMW-14 20-Aug-99 Water Field Sample A9H240148002 16-Sep-99	RFIMW-22 RFIMW-22 19-Aug-99 Water Field Sample A9H210120004 16-Sep-99	RFIMW-23 RFIMW-23 19-Aug-99 Water Field Sample A9H210120002 16-Sep-99	RFIMW-29 RFIMW-29 23-Aug-99 Water Field Sample A9H250128001 13-Sep-99	PM4NA PM4NA 23-Aug-99 Water Field Sample A9H250128002 13-Sep-99
Analyte						
pH	--	6.47	10.45	5.75	7.01	8.34
Dissolved Oxygen	mg/L	4.76	8.09	1.68	6.22	0.55
Temperature	°C	13.8	15.6	16.6	18.3	12.6
Oxidation Reduction Potential	mV	-106	-500	-95	77	--
Calcium	mg/L	2040	103	271	556	108
Total Iron	mg/L	25.4	2.8	4.07	4.8	3.88 ⁽¹⁾
Ferrous Iron	mg/L	10	1.3	0.72	1	3.88
Hardness, as CaCO ₃	mg/L	7000	340	790	1100	1000
Total Alkalinity	mg/L	700	6200	150	430	8600
Total Dissolved Solids (TDS)	mg/L	77000	15000	3200	7300 J	43000 J
Total Solids (TS)	mg/L	77000	--	--	7800 J	42000 J
Chemical Oxygen Demand (COD)	mg/L	117	300	64.4	53.3	1470
Total Organic Carbon (TOC)	mg/L	7 J	740 J	10 J	5 J	360 J
Langelier Index (LI)	--	1.20	4.15	-1.59	0.19	2.71
COD/TOC ratio	--	16.71	0.41	6.44	10.66	4.08

(1): As discussed in the text, the ferrous iron present in these samples probably was oxidized and precipitated from solution, resulting in the lower total iron measurements. For the purposes of this evaluation, it was assumed that the total iron results from these locations are the same as the ferrous iron results.

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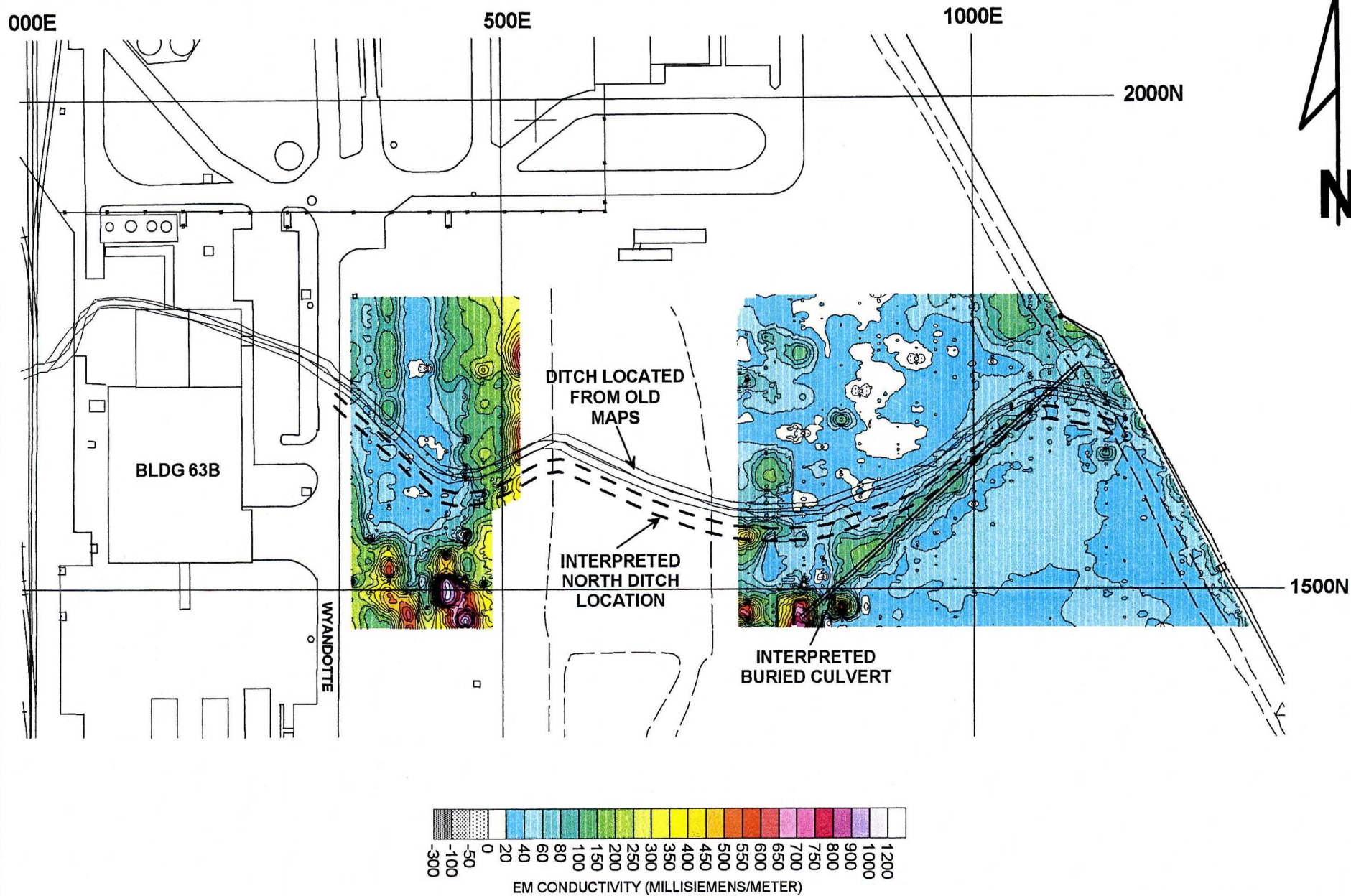
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TABLE 4.4
COMPARISON OF RESULTS TO MDEQ STANDARDS

BASF NORTH WORKS FACILITY
WYANDOTTE, MICHIGAN

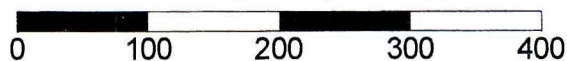
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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date	MDEQ GSI-Based Groundwater Cleanup Levels (May 28, 1999)		RFIMW-1 RFIMW-1 19-Aug-99 Water Field Sample A9H210120006 16-Sep-99	RFIMW-22 RFIMW-22 19-Aug-99 Water Field Sample A9H210120004 16-Sep-99	RFIMW-23 RFIMW-23 19-Aug-99 Water Field Sample A9H210120002 16-Sep-99	RFIMW-29 RFIMW-29 23-Aug-99 Water Field Sample A9H250128001 13-Sep-99	PM4NA PM4NA 23-Aug-99 Water Field Sample A9H250128002 13-Sep-99
Analyte							
Acetone	1700	ug/L	240 J	8000 J	--	--	--
Benzene	12	ug/L	120	2600 J	--	--	--
Bromomethane	35	ug/L	2.7 J	--	--	--	--
Carbon disulfide	--	ug/L	--	--	--	--	--
1,2-Dichloropropane	9.1	ug/L	--	--	--	--	--
Ethylbenzene	18	ug/L	--	--	--	--	--
Methylene chloride	47	ug/L	--	--	--	4.6 U*	30 U*
Styrene	80	ug/L	--	--	--	--	--
Toluene	140	ug/L	--	110 U*	--	--	--
Vinyl chloride	15	ug/L	9.4 J	370 J	--	--	--
o-Xylene	35	ug/L	--	--	--	--	--
Benzo(a)anthracene	--	ug/L	--	--	3.3 J	--	--
2,4-Dimethylphenol	12	ug/L	--	--	--	--	--
Fluoranthene	1.6	ug/L	--	--	15 J	--	--
Naphthalene	13	ug/L	--	--	--	--	--
Phenol	210	ug/L	--	220 J	--	--	--
2-Picoline	--	ug/L	--	--	--	--	--
Pyrene	--	ug/L	--	--	9.6	--	--
Pyridine	--	ug/L	--	--	--	--	--
bis(2-Chloroisopropyl) ether	--	ug/L	--	--	--	--	--
1,4-Dioxane	34	ug/L	120 J	87 J	--	--	--



**BASF NORTH WORKS
WYANDOTTE, MICHIGAN**

**MAP SCALE
(in feet)**



**NORTH AREA:
EM38 CONDUCTIVITY
CONTOUR MAP**

6/28/99

GEOSPHERE

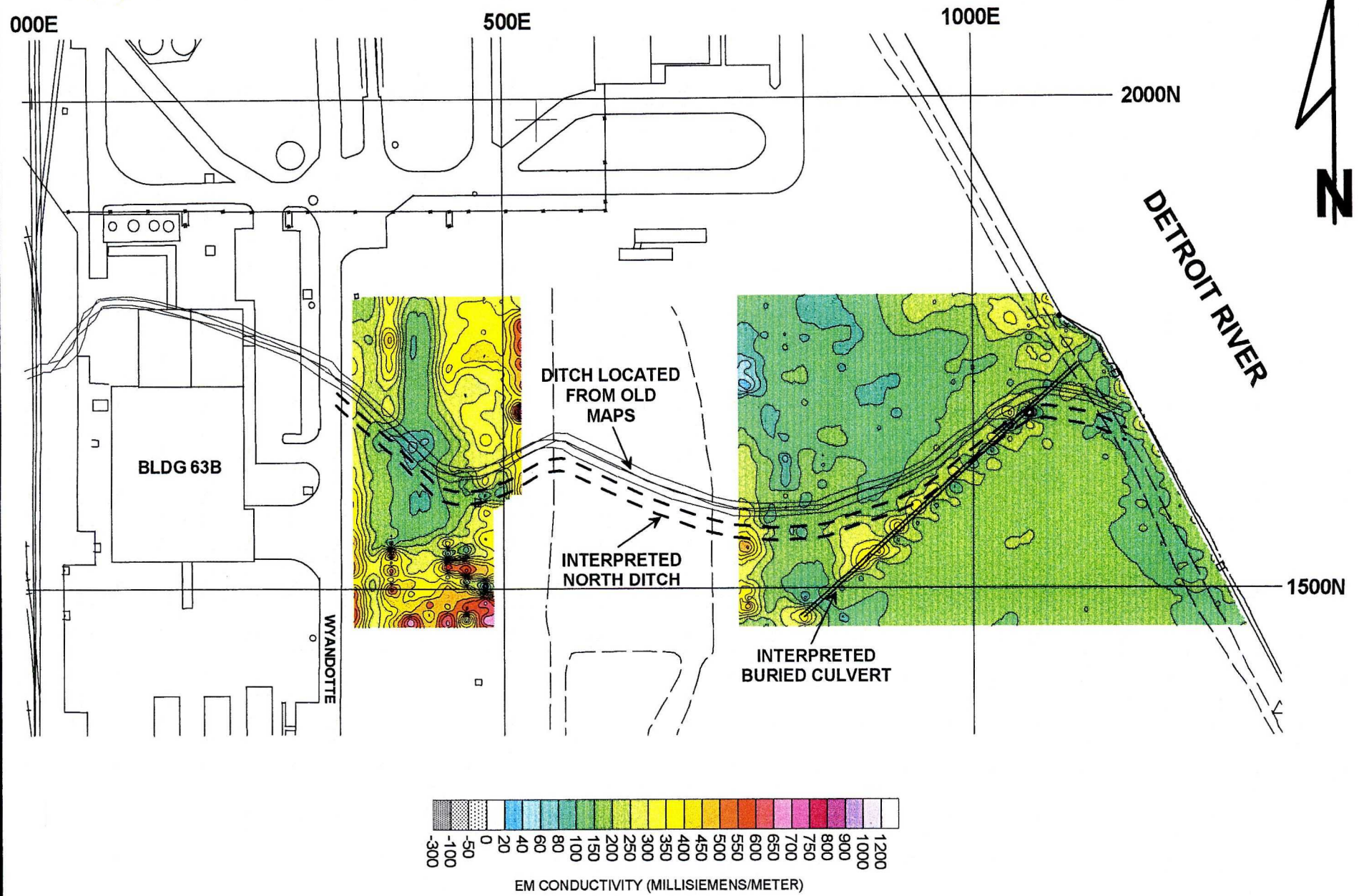


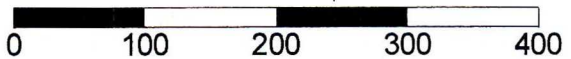
FIGURE 4.2

**BASF NORTH WORKS
WYANDOTTE, MICHIGAN**

6/28/99

GEOSPHERE

**MAP SCALE
(in feet)**



**NORTH AREA:
EM31 CONDUCTIVITY
CONTOUR MAP**

FIGURE 4.3

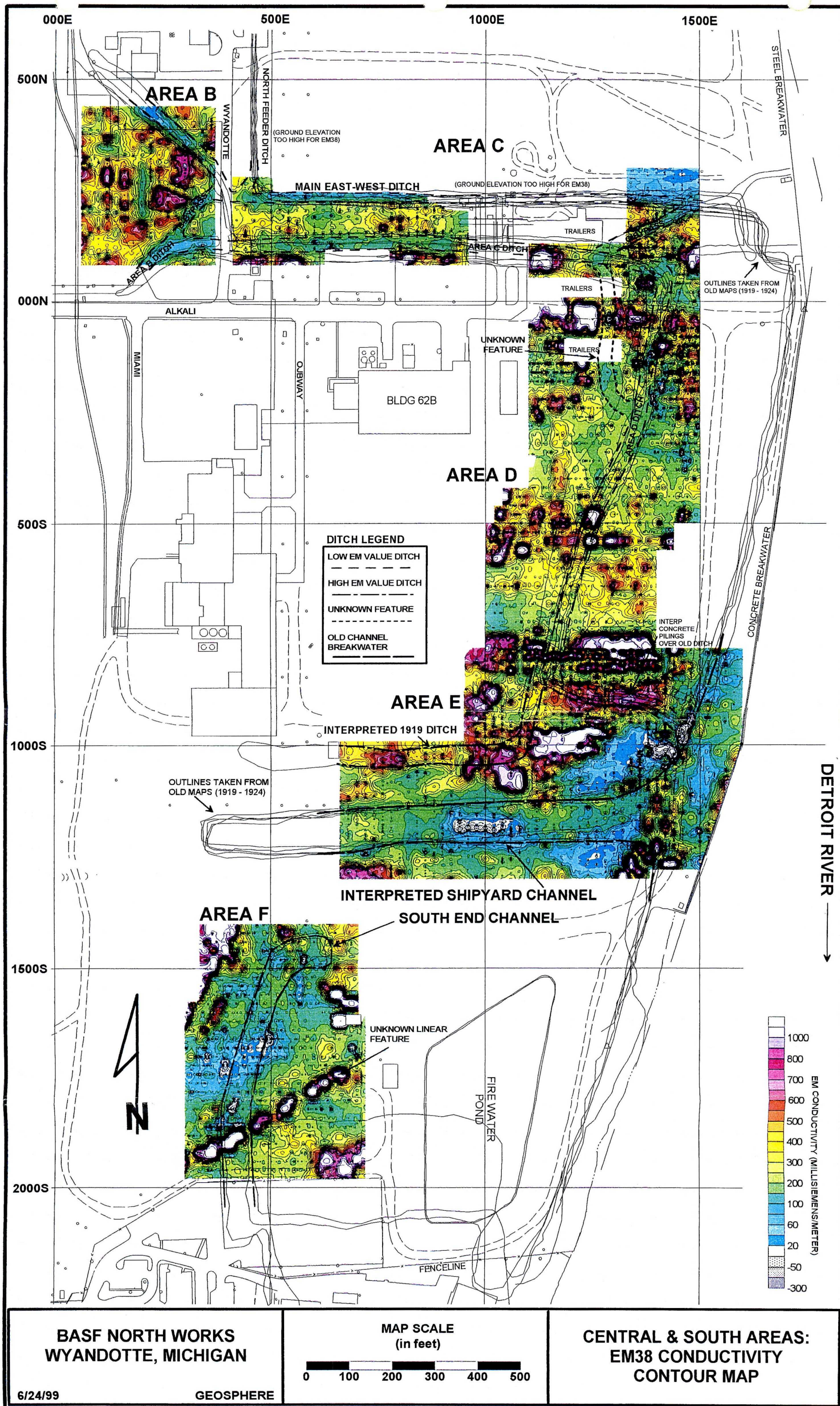
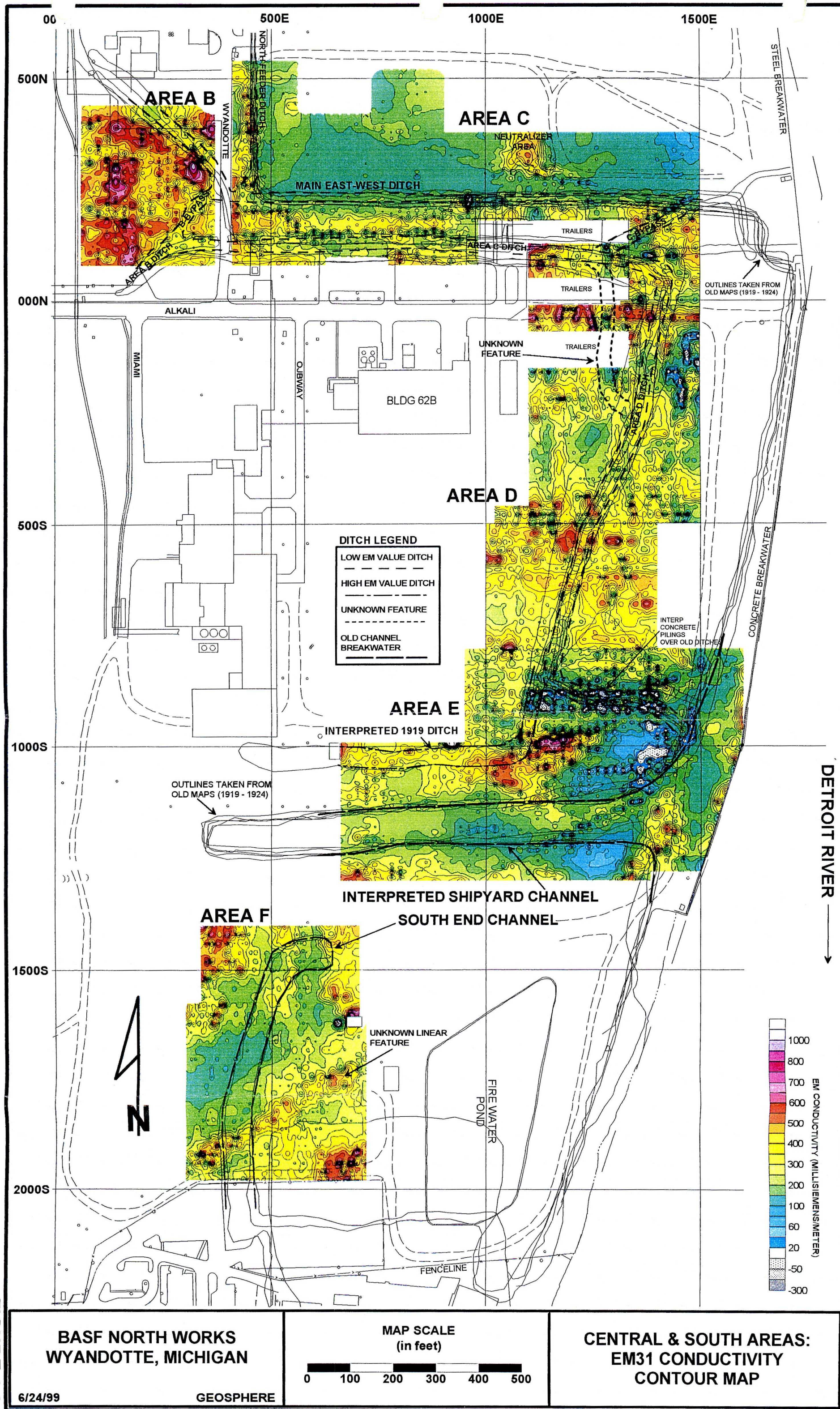


FIGURE 4.4



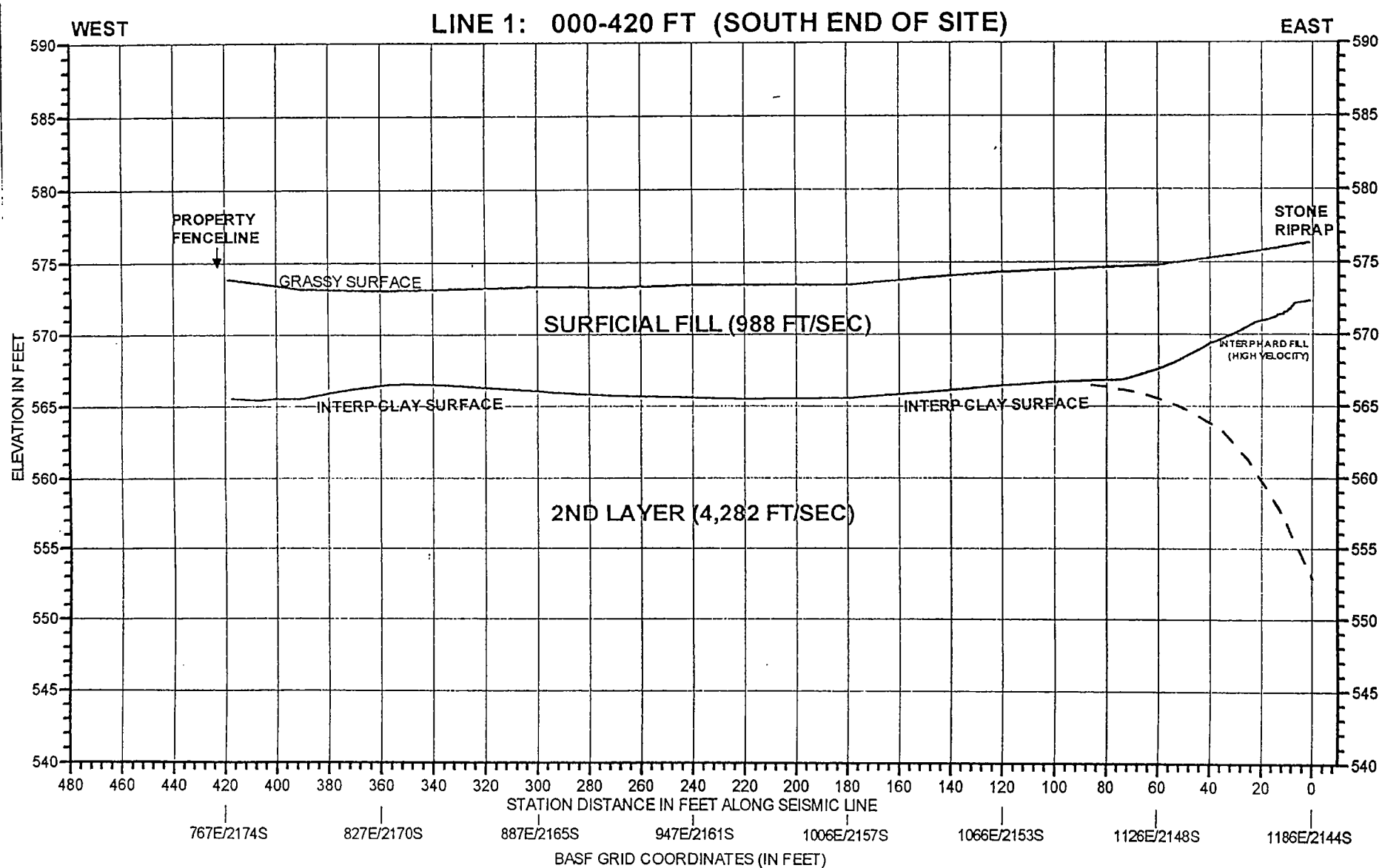


FIGURE 4.6
SEISMIC REFRACTION LINE 1
INTERPRETED SEISMIC/GEOLOGIC SECTION
BASF CORPORATION - WYANDOTTE, MICHIGAN
PARSONS ENGINEERING SCIENCE, INC.

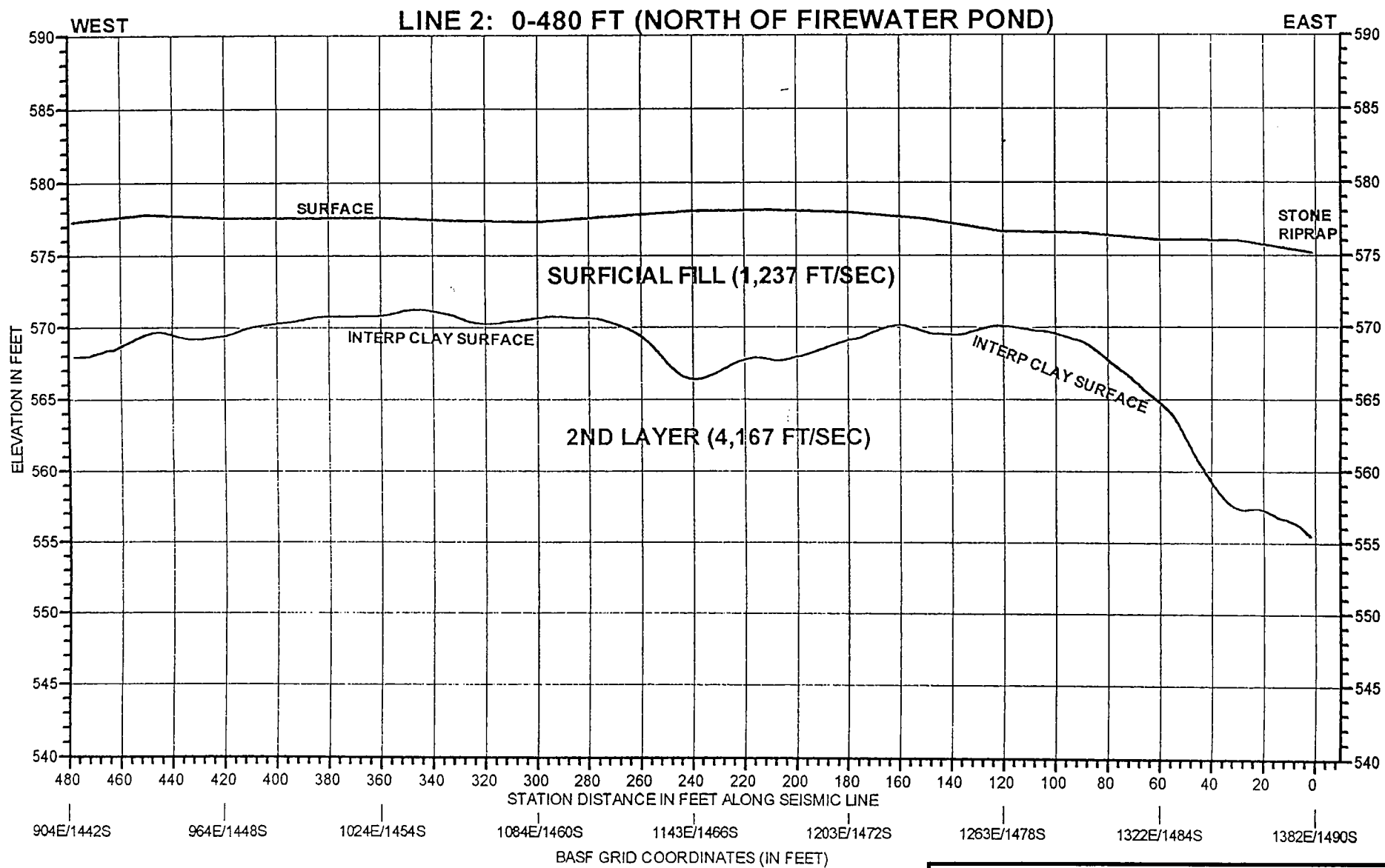


FIGURE 4.7
SEISMIC REFRACTION LINE 2
INTERPRETED SEISMIC/GEOLOGIC SECTION
BASF CORPORATION - WYANDOTTE, MICHIGAN
PARSONS ENGINEERING SCIENCE, INC.

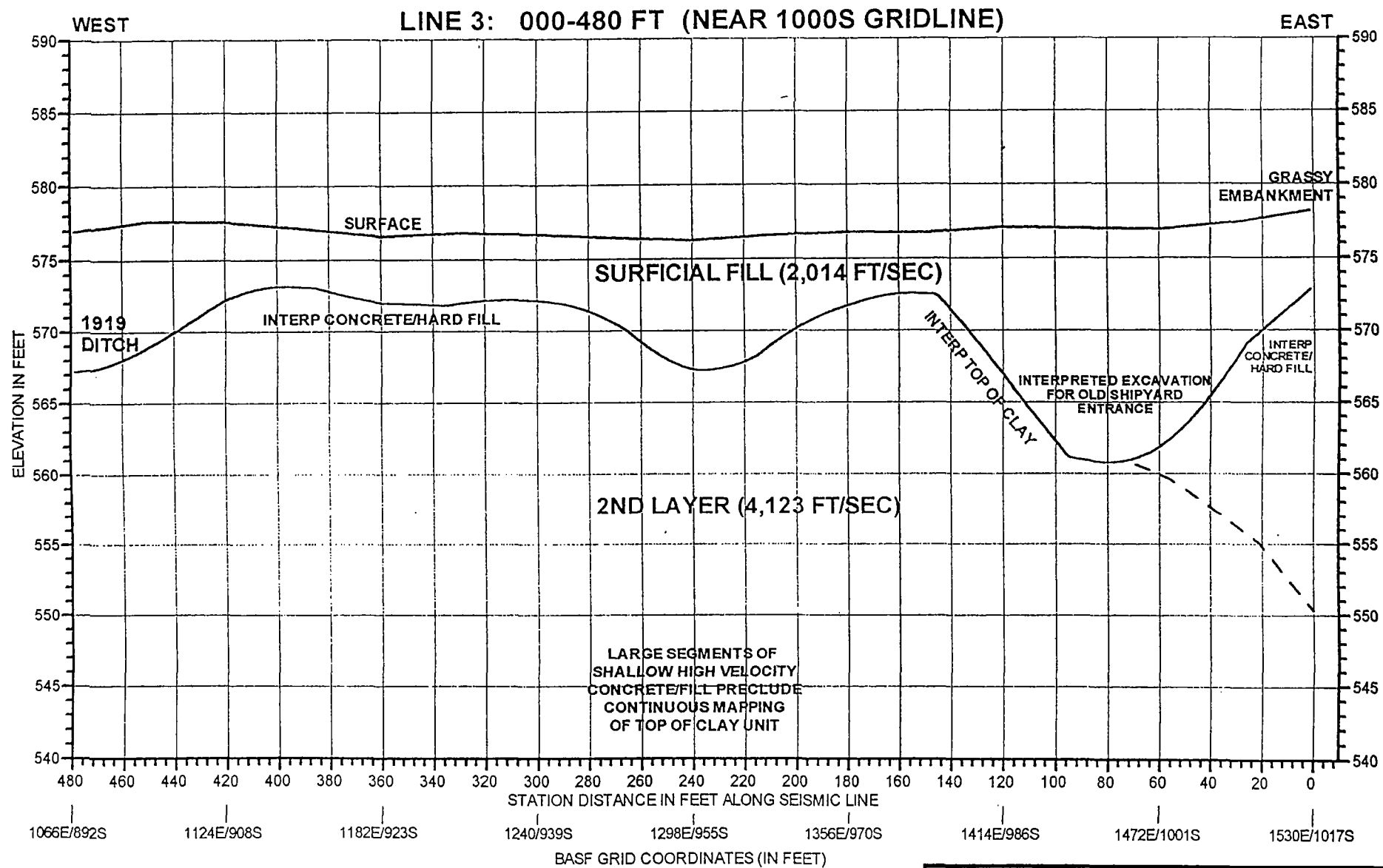


FIGURE 4.8
SEISMIC REFRACTION LINE 3
INTERPRETED SEISMIC/GEOLOGIC SECTION
BASF CORPORATION - WYANDOTTE, MICHIGAN
PARSONS ENGINEERING SCIENCE, INC.

LINE 4: 0-480 FT (NEAR 500S GRIDLINE)

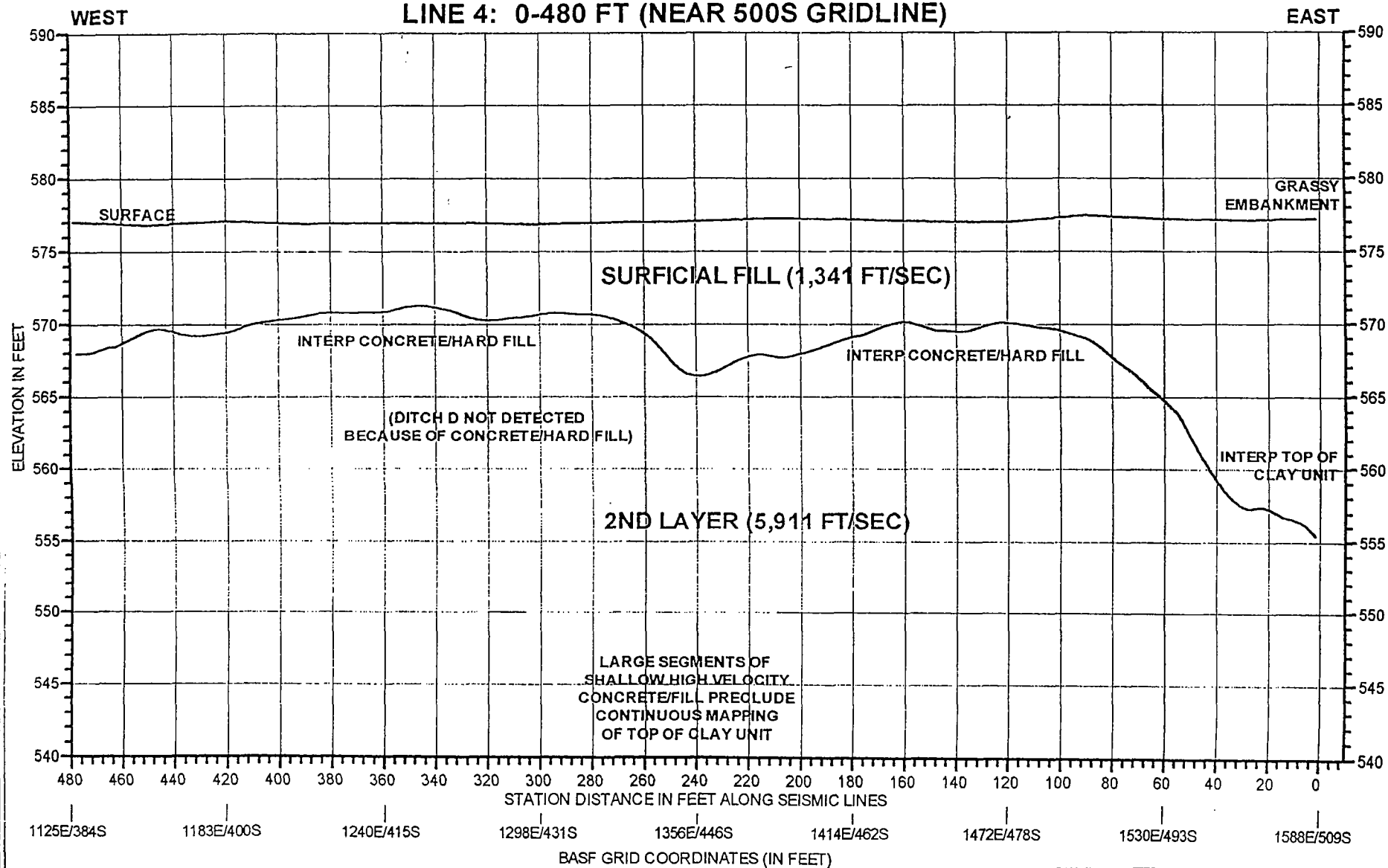


FIGURE 4.9
SEISMIC REFRACTION LINE 4
INTERPRETED SEISMIC/GEOLOGIC SECTION
BASF CORPORATION - WYANDOTTE, MICHIGAN
PARSONS ENGINEERING SCIENCE, INC.

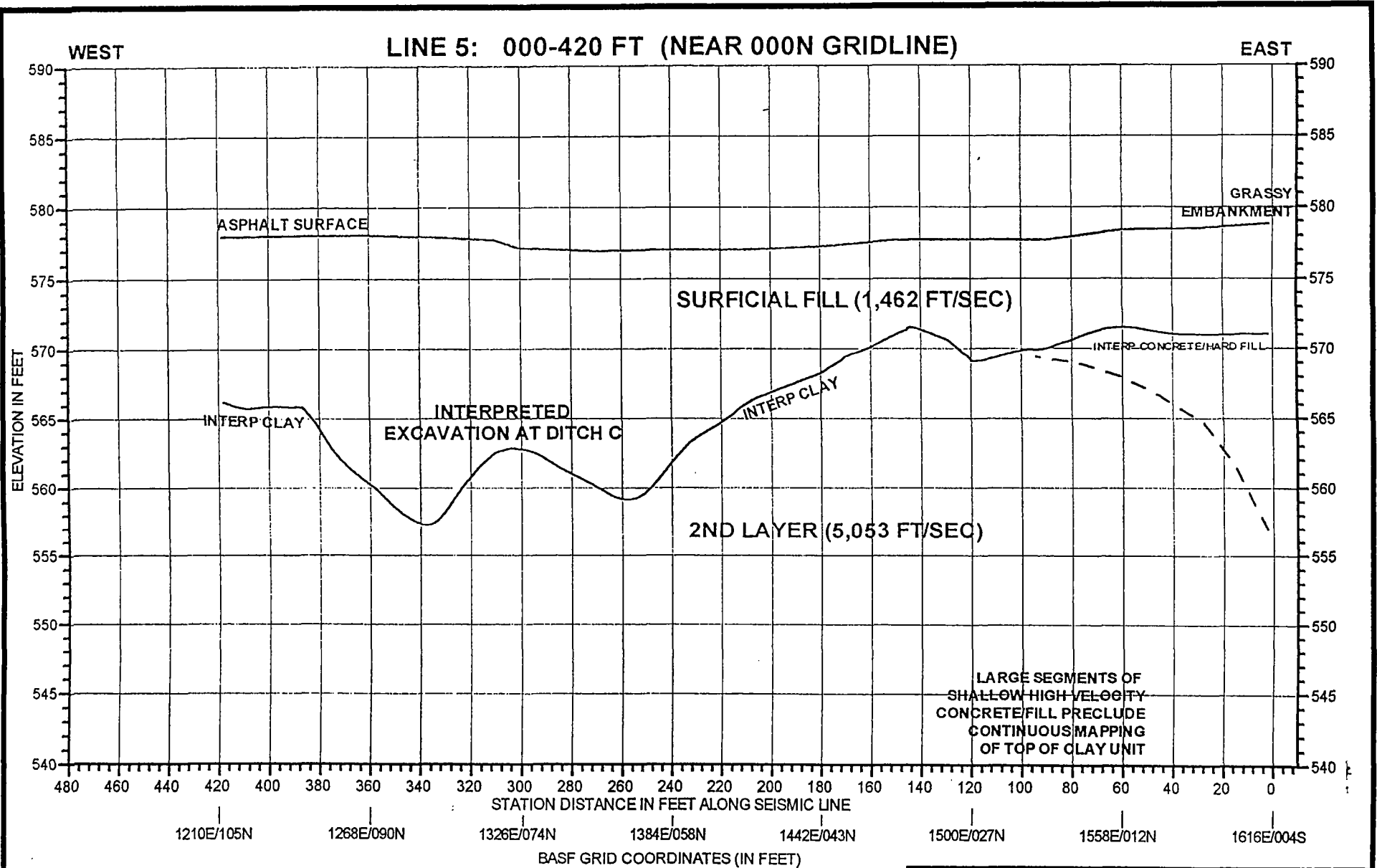
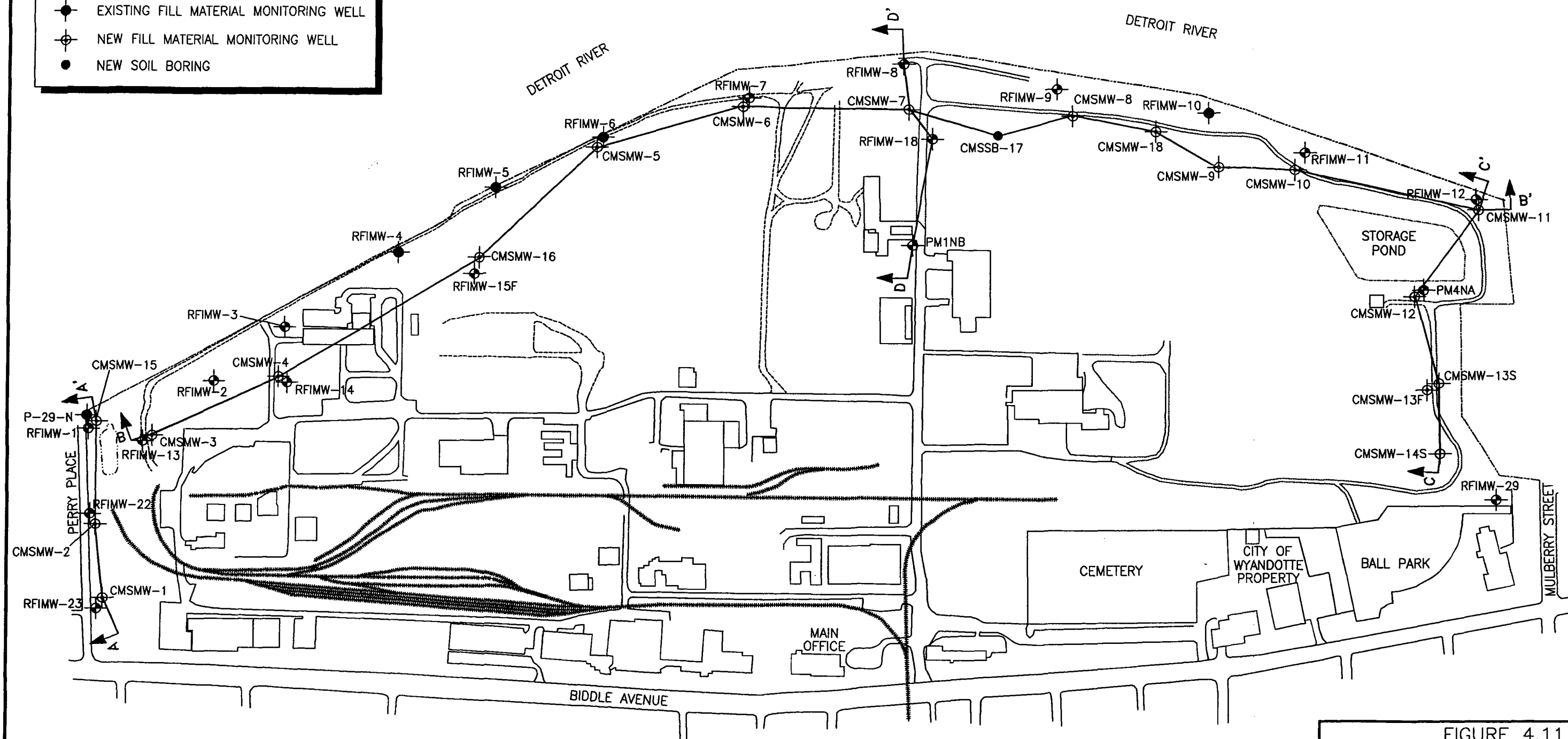


FIGURE 4.10
SEISMIC REFRACTION LINE 5
INTERPRETED SEISMIC/GEOLOGIC SECTION
BASF CORPORATION - WYANDOTTE, MICHIGAN
PARSONS ENGINEERING SCIENCE, INC.

LEGEND

- ⊕ EXISTING NATIVE SAND MONITORING WELL
- ⊕ NEW NATIVE SAND MONITORING WELL
- ⊕ EXISTING FILL MATERIAL MONITORING WELL
- ⊕ NEW FILL MATERIAL MONITORING WELL
- NEW SOIL BORING



DATE: 2/22/00 [nw]
R:\DRAWINGS\BASF\33893017.DWG

0 400 800
SCALE: 1"=400'

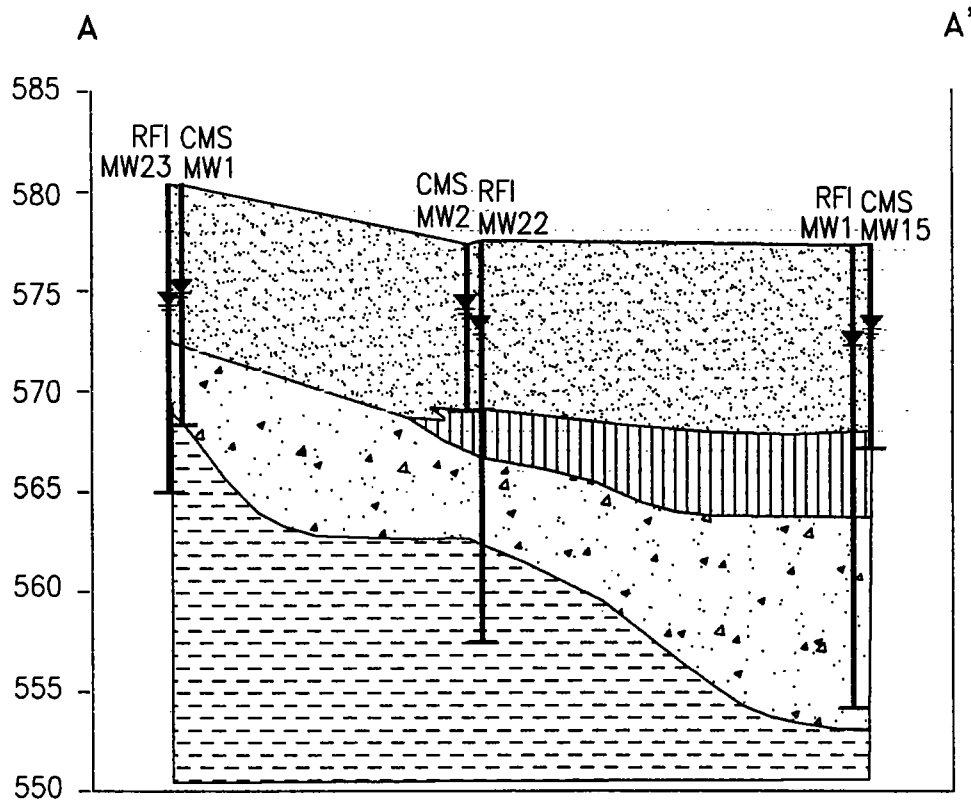
FIGURE 4.11

BASF CORPORATION
WYANDOTTE, MICHIGAN

CMS FIELD INVESTIGATION
NEW AND EXISTING GROUNDWATER
MONITORING WELL LOCATIONS
AND CROSS SECTION LOCATIONS

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LEGEND



VERTICAL SCALE:
1"=10'

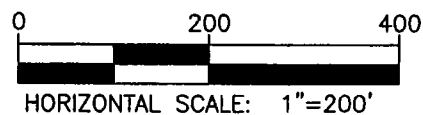
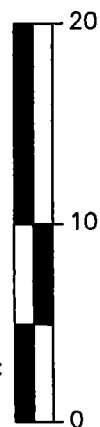


FIGURE 4.12

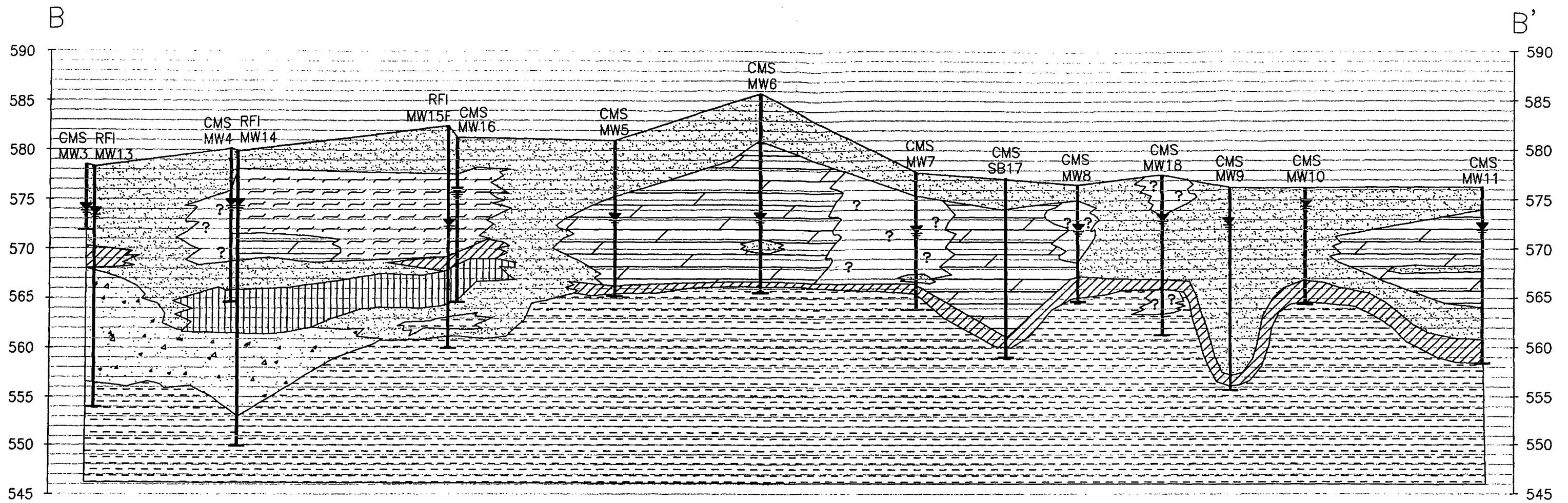
BASF CORPORATION
WYANDOTTE, MICHIGAN

CMS FIELD INVESTIGATION CROSS SECTION A-A'

PARSONS ENGINEERING SCIENCE, INC.

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LEGEND

	SAND/FILL		INDUSTRIAL FILL (PUTTY)
	PEAT		INDUSTRIAL FILL (RUBBLE)
	NATIVE SAND		WATER LEVEL
	CLAY		NO RECOVERY
	SILT		

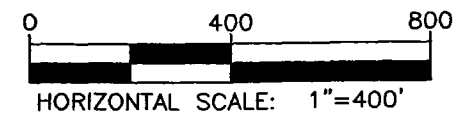
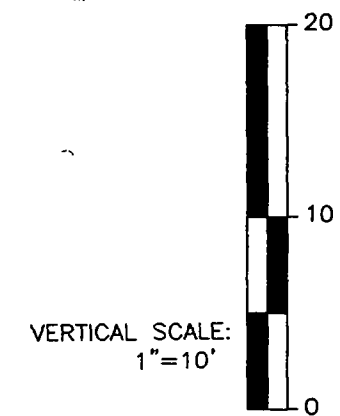


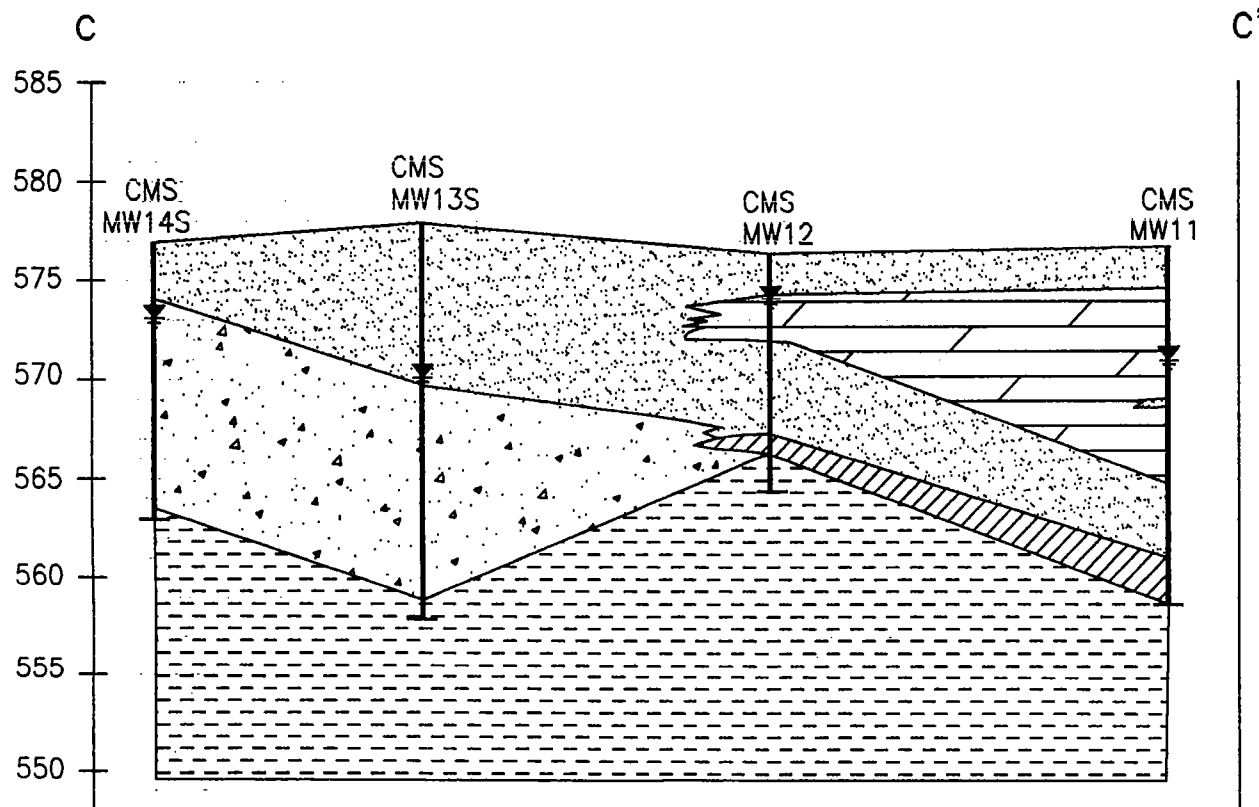
FIGURE 4.13

BASF CORPORATION
WYANDOTTE, MICHIGAN







CMS FIELD INVESTIGATION CROSS SECTION B-B'

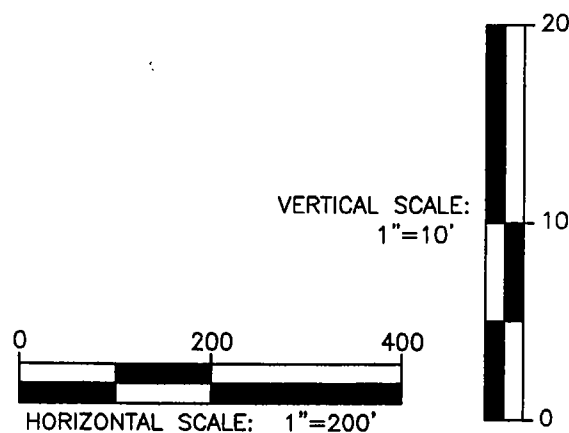
PARSONS ENGINEERING SCIENCE, INC.

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LEGEND

-  SAND/FILL
-  PEAT
-  NATIVE SAND
-  CLAY
-  INDUSTRIAL FILL (PUTTY)
-  WATER LEVEL



DATE: 2/1/00 [NW]
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FIGURE 4.14

BASF CORPORATION
WYANDOTTE, MICHIGAN

CMS FIELD INVESTIGATION
CROSS SECTION C-C'

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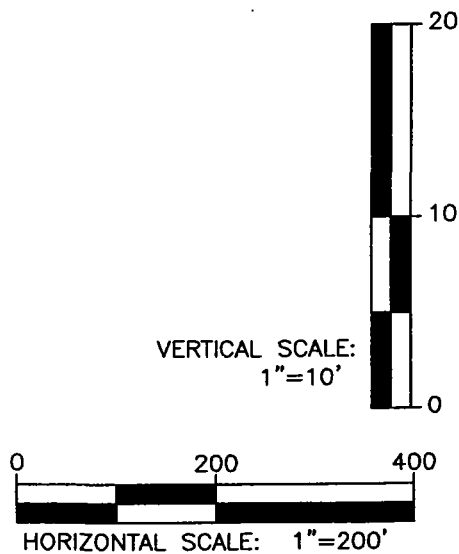
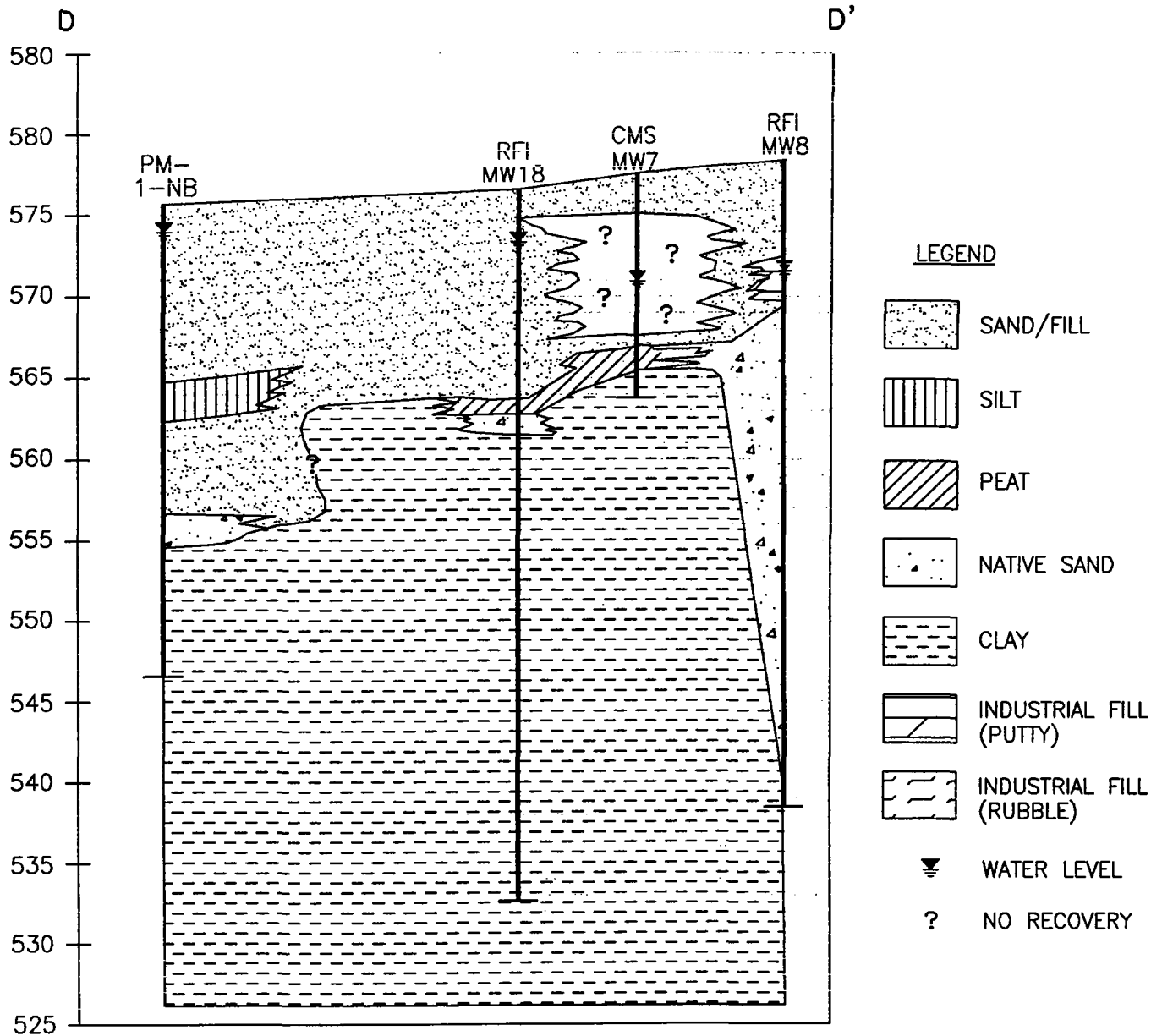


FIGURE 4.15

BASF CORPORATION
WYANDOTTE, MICHIGAN

CMS FIELD INVESTIGATION
CROSS SECTION D-D''

PARSONS ENGINEERING SCIENCE, INC.
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DATE: 2/1/00 (NW)
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SECTION 5

SUMMARY

The analysis of the aquifer pumping test data indicates that there is almost no hydraulic communication between the fill and Native Sand Units underlying the Facility; therefore, there is no flow between these units. Given these results, any containment system designed to pump from the upper fill layer alone will not control flow in the lower Native Sand Unit and, therefore, will not effectively achieve groundwater containment. Hence, any containment/extraction alternative will need to address groundwater in each stratigraphic unit separately.

The analysis of the slug test data shows that the horizontal hydraulic conductivity of the materials underlying the Facility are moderate to high near the boundaries of the Facility. These data indicate that a containment strategy relying solely on pumping will likely pull a significant amount of surface water from the Detroit River and result in large volumes of water requiring treatment.

Given the elevated iron levels present in the groundwater and the positive LI values observed in most wells, there is an increased potential for precipitation and fouling of pumping/treatment equipment. As such, the reliability of any groundwater containment alternative that is based solely on pumping is problematic.

The lacustrine clay unit appears to underlie the entire study area, and is typically a hard, relatively impermeable clay. The depth to the clay unit varies between 8 and 20 feet below grade, with regional information indicating the clay unit exists to depths of 70 feet or more, and overlies limestone or dolomite bedrock. However, it is within this clay unit that features such as the shipyard channel, drainage ditches, and old Facility foundations appear to have been incised.

Based on the groundwater potentiometric surface, groundwater is leaving the Facility along the northern and southern boundaries in the fill unit. Along the northern boundary, groundwater is flowing off-site also in the Native Sand Unit. At the southern boundary of the Facility, groundwater in the Native Sand Unit is flowing northward toward the extraction system and does not appear to be going off-site.

The flux emission chamber analysis performed at SWMU H during the CMS field program, to quantify the surface VOC emissions in this area, showed that 1,2-dichloropropane was undetected in all air samples. Accordingly, the resultant risk values posed by this compound will be less than 10^{-6} . Since 1,2-dichloropropane accounted for 99 percent of the total carcinogenic risk identified for SWMU H (calculated by the preliminary risk assessment performed during the RFI), the data from the CMS field program shows there is no unacceptable inhalation risk at SWMU H. As such, the inhalation exposure pathway may be eliminated from further consideration as part of the CMS.

SECTION 6 REFERENCES

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**GEOPHYSICAL SURVEY
FOR OLD DITCHES, CHANNELS
AND CLAY RIDGE
AT THE
BASF NORTH WORKS
Wyandotte, Michigan**

**for
Parsons Engineering Science
and
BASF**

June 1999

**GEOSPHERE INC
Midland, Michigan**

30 June 1999

Mona Sutherland
Parsons Engineering Science, Inc.
1000 Jorie Blvd, Suite 250
Oak Brook, Illinois 60523

**Re: BASF Site, Detroit, Michigan: Transmittal of Geophysical Report
Parsons ES Project # 733893-000-05
Geosphere Project #99-528**

Dear Mona:

We have completed our report describing the May 1999 geophysical survey of portions of the BASF North Works site in Wyandotte, Michigan. This work included investigation with EM38, EM31 and seismic techniques for the detection and mapping of old drainage ditches and a clay ridge.

The EM38 and EM31 survey detected and confirmed the location of former drainage ditches and channels identified on old maps in the northern, central and southern parts of the site along the Detroit River. The ditches and channels appeared as linear patterns of lower conductivity caused by the presence of fill materials, contrasted with surrounding soil having higher electrolyte (salt) content. Many portions of the central and southern ditches/channels are associated with negative anomalies interpreted as concrete/rebar pilings likely associated with old breakwaters and building foundations.

The seismic refraction survey provided different types of information in different portions of the site sampled by the five refraction lines. The clay ridge was identified in the southern two lines and portions of the clay surface and hard fill were found in the northern three lines (Lines 3, 4 and 5). Due to the presence of old foundations of a former alkali plant and the shallowness of the clay ridge in the area of question along the river, a definitive map of the top of the ridge was not possible. However, the seismic data indicate that the old plant foundations and hard fill were likely anchored into the clay, replacing any sand layers that might have previously existed. The seismic data also identified old excavations interpreted as portions of the old shipyard channel entrance and drainage ditches (Ditch C and 1919 Ditch).

Sincerely,



Robert A. Glaccum, PG
Project Manager

**GEOPHYSICAL SURVEY
FOR OLD DITCHES, CHANNELS
AND CLAY RIDGE
AT THE
BASF NORTH WORKS
Wyandotte, Michigan**

**for
Parsons Engineering Science
and
BASF Corporation**

June 1999

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1 INTRODUCTION

1.1 LOCATION AND DESCRIPTION

A geophysical survey was conducted at the BASF North Works site, located in Wyandotte, Michigan. Wyandotte is situated along the Detroit River some 5 miles south of the City of Detroit in southeastern Michigan. The North Works property is located immediately east of Biddle Avenue along the river just north of downtown Wyandotte (Figure 1.1).

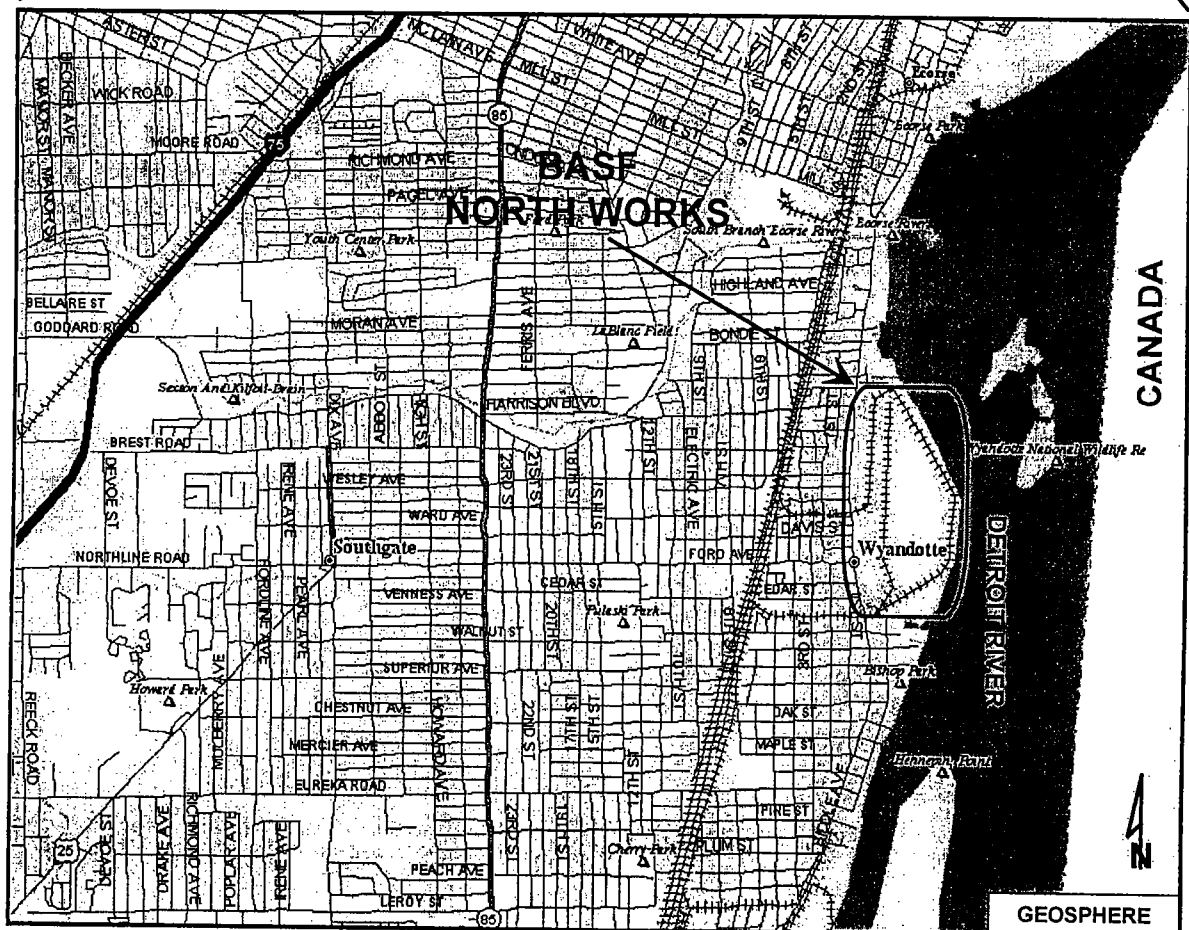
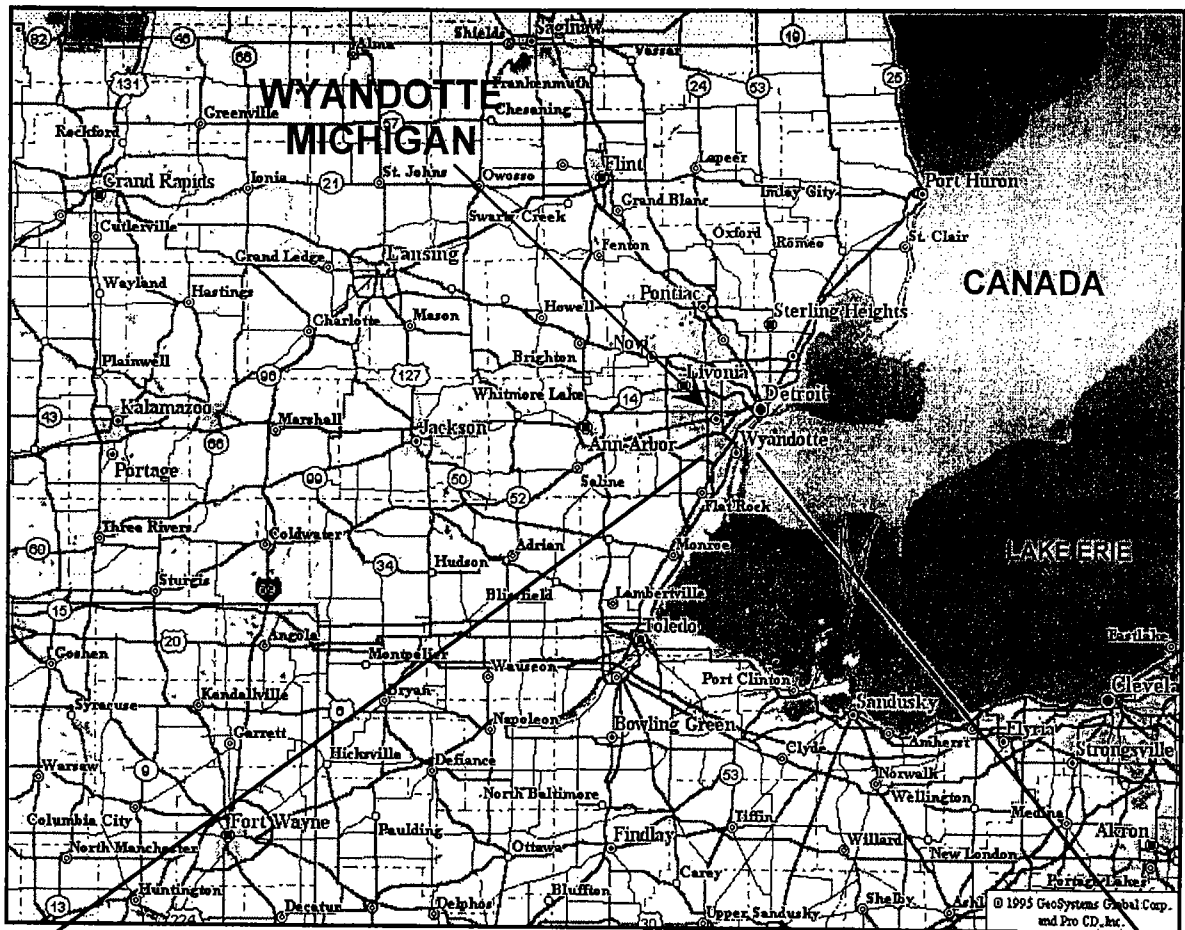
The property occupies over 200 acres, oriented in a north-south direction along the western bank of the river. Present BASF plant buildings are concentrated in the western portion of the site some 700 to 2000 feet west of the river. Since the turn of the century, various industries and plant buildings were active in the eastern portion near the river, particularly in the central and southern zones of the site. These included a former shipyard at the southern end and a very large alkali plant in the central area. Prior to 1930, large channels were used for the shipyard operations in the southern area and ditches were constructed in the northern and central areas to convey drainage from the western sector to the river (Figure 1.2). Subsequent construction of the alkali plant would have necessitated filling or bridging many of these ditches and channels. Today, the primary east-west ditch is replaced with a liner and covered with several feet of fill. The remaining ditches and channels are completely filled in with no visible surface expression.

As part of a site assessment, it was determined that these former ditches and channels might have permitted the movement of contaminants from the western plant sector to the river. A natural subsurface barrier of clay exists in the eastern sector as determined from geologic logs of monitor wells installed in the area; however, the exact configuration of the clay ridge is not known but is believed to have an axis approximately parallel to the south-central shoreline some 150 feet inland. Well data shows a steep eastern face of the clay which is an erosional feature likely caused by past activity of the Detroit River. To the west, the clay surface dips slightly and rises up under the western sector.

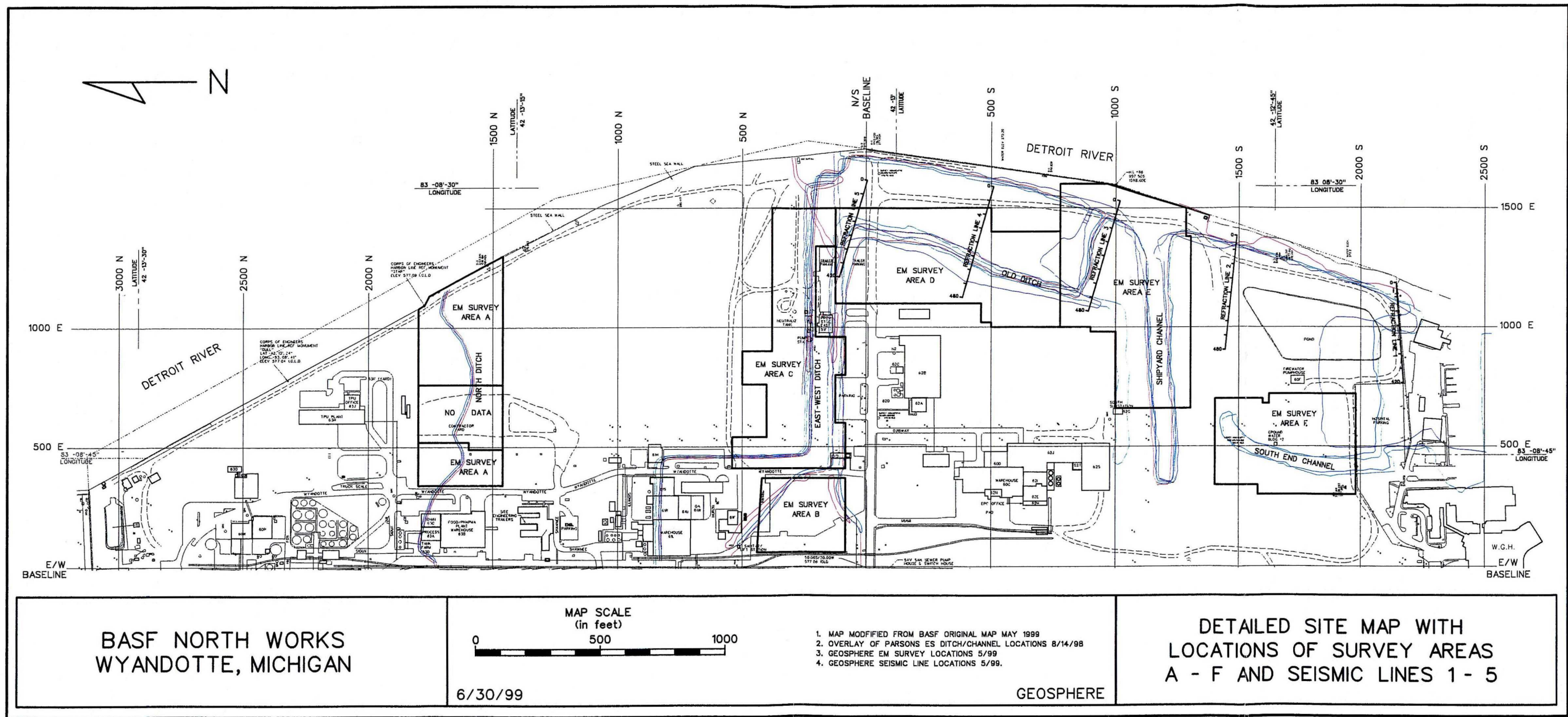
1.2 PURPOSE

Geosphere was contracted by Parsons ES and BASF to detect and accurately map the buried ditches and channels and determine the shape and axis of the clay ridge along the river using geophysical methods. These methods included electromagnetics (EM) and seismic refraction. EM instruments are capable of measuring large and small variations in ground conductivity. Seismic refraction procedures are capable of measuring seismic velocities along strings of geophones; once processed, depths to significant layers such as clay units and bedrock can be determined.

The combined EM and seismic surveys were conducted 17 through 28 May 1999.



LOCATION MAP OF BASF NORTH WORKS, WYANDOTTE, MICHIGAN



2 GEOPHYSICAL METHODS

2.1 GENERAL DESCRIPTION

Two different geophysical methods employing three instruments were used at the BASF North Works in Wyandotte, Michigan:

- 1) Electromagnetics - EM38 recording conductivities to 6 feet depth
- 2) Electromagnetics - EM31 recording conductivities to 20 feet depth
- 3) Seismic -- high resolution shallow refraction.

A description for each method is given below as it applies to the site.

2.2 EM TECHNIQUE

EM was used to locate conductivity changes and anomalies that might represent buried ditches caused by increased salt content at the bottom of the ditch or by contrasting fill used to cover the abandoned ditch or channel.

The Geonics EM38 and EM31 instruments were used because they:

- 1) provide conductivity information to 6 and 20+ feet depth with excellent lateral resolution
- 2) are capable of resolving features such as buried ditches, channels and other linear features
- 3) can be easily outputted to a digital recorder for near-continuous profile coverage.

The EM induction method determines electrical properties of earth materials by inducing electrical currents in the ground and measuring the secondary magnetic field produced by these currents. An alternating current is generated in a wire loop or coil above the ground's surface; both the primary magnetic field (produced by the transmitter coil in the instrument) and the secondary field (produced by currents in the earth) induce a corresponding alternating current in the receiver coil of the instrument. The coils are kept at a fixed distance and orientation to simplify handling of the data (Appendix A).

After compensating for the primary field (which can be computed from the relative positions and orientations of both coils), both the magnitude and relative phase of the secondary field are measured. These measurements are then converted to components of inphase and 90 degrees out-of-phase with the transmitted field. The out-of-phase (or quadrature-phase) component, using certain simplifying assumptions, is converted to a measure of apparent ground conductivity. This apparent conductivity conversion assumes a homogeneous, isotropic earth. In practice, this value is an estimate of the average conductivity of the ground in the proximity of the instrument, to a depth of investigation (approximately 6 feet for the EM38 and 20 feet for the EM31) which is dependent on the coil spacing (1 and 3.66 meters, respectively), orientation, operating frequency, and the conductivity distribution of the earth.

Data quality of the conductivity (quadrature) signal may be degraded by the presence of cultural interference such as that caused by utility lines, steel fences, and large metallic objects whose high conductivity values may overwhelm the conductivity of the ground itself. Often, very high metallic responses will cause negative values in the quadrature data. Both the quadrature and inphase data can be recorded in analog or digital form on two channel, battery-powered recorders.

At this site, conductivity data were recorded digitally on an OmniData logger unit in units of milliSiemens/meter (mS/m).

2.3 SEISMIC REFRACTION TECHNIQUE

Seismic refraction was employed to detect and map soil, fill and clay units. By determining seismic wave arrivals and seismic velocities in soil and fill layers above the clay, the density nature (in terms of seismic velocity) of the layers could be assessed as well as provide input for permitting the calculation of the depth of the clay unit. Refraction data were processed using the Generalized Reciprocal Method (GRM) of analysis that provides much greater detail of subsurface conditions than the older plane methods of forward/reverse refraction.

Seismic methods are used to measure the depth and thickness of geologic strata using acoustic (sound) waves transmitted into the ground. These waves, generated from a controlled source, travel in different directions and velocities through various soil and rock layers. During this traveling, these waves are refracted and reflected from various interfaces in the subsurface. The time required for the wave to traverse this path through these layers and return to the surface permits calculation of layer depth and velocity (Appendix A). Refractions are most often received from significant interfaces having sufficient thickness such as between soil, fill, compacted sediments, top of water, top of bedrock, and contrasting intra-bedrock layers.

Primary seismic waves move through subsurface geologic layers in response to layer physical properties (acoustic impedance), layer thickness, and layer sequence. A significant change in any one of these parameters will cause a notable shift in the seismic wave's velocity and path of travel. Layer density and elastic properties primarily determine the velocity at which the acoustic energy will travel through the layer; these properties are determined largely by the more recognizable attributes of water content, compaction, porosity, and mineral composition.

GRM refraction methods require extensive computer processing. Using close geophone spacings of 2.5 feet, specialized field methods permit acquisition of data as shallow as 2 feet and variations of the clay/rock interface along the line. Refraction data are based on "picks" of the first primary seismic wave arrival times for each geophone in the array.

A seismograph is used to collect, process and display seismic wave arrivals from a geophone array. The seismic energy source may be a hammer striking a metal plate, shotgun device or a drop weight. A 12 pound hammer was used as a source, being appropriate to meet site requirements (shallow clay, tight spacings and speed of data acquisition).

The vertical resolution and minimum usable depth for seismic methods are dependent on several factors:

- 1) Frequency transmitted by the subsurface (often a function of grain size and depth to water table)
- 2) Seismic velocities of surface soils/sediments
- 3) Frequency characteristics of geophones
- 4) Filter capabilities of seismograph
- 5) Resolution capabilities of seismograph.

Higher seismic frequencies will permit better resolution of subsurface layers. Different ground conditions will transmit different frequencies (ranging from less than 1 to over 500 Hz) with various attenuation. Refraction methods require that the sequence of natural or fill layers must increase in velocity with increasing depth.

The seismic data were collected with a 48 channel, Bison 9000 seismograph with digital floating point gain

control and 96 geophones. The system was coupled to two spread extension cables via a roll box to allow more rapid acquisition of data from four 24-geophone arrays without moving the seismograph. A 12 pound hammer was employed as a seismic energy source to generate P-wave energy. A 10-inch square steel plate was employed to generate a "sharper" seismic signal than that obtainable using the hammer on normal, uncompacted surfaces. Thirty hertz (low-cut) Marks Product geophones were used to measure in the incoming seismic signals.

3 DATA ACQUISITION

3.1 SURVEY AREAS AND COVERAGE

This chapter provides a general description of grid setup, survey procedures and survey location for each of the geophysical methods. Grid nodes and lines were set up using BASF's universal grid system for North Works. Our grid lines and flags were directly measured from grid reference monuments found at various locations over the site. Colored flags were placed at 20-foot intervals on the 1500N, 200N, 000N, 500S, 1000S, 1500S, 500E, 1000E, and 1500E gridlines as a reference grid.

Because the various ditches and channels identified in the old maps are quite widespread, we defined six specific survey areas in which the EM coverage would be approximately perpendicular to the suspected ditch feature of interest. These areas are highlighted in Figure 1.2 and are labeled:

Area A:	north area bounded by gridlines 1460N to 1800N	lines run North-South
Area B:	central area bounded by gridlines 60E to 370E	lines run North-South
Area C:	central area bounded by gridlines 410E to 1500E	lines run North-South
Area D:	central area bounded by gridlines 780S to 120N	lines run East-West
Area E:	central area bounded by gridlines 1300S to 780S	lines run North-South
Area F:	south area bounded by gridlines 1980S to 1400S	lines runs East-West

At each of the six areas, Geosphere placed grid flags at 40-foot intervals in north-south and east-west directions using 300-foot surveyor tapes; flags were placed at 20-foot intervals on gridlines at the edges of each area. Red spray paint was used to mark grid nodes in roadway and paved areas.

Except for a few locations, the entire gridded area was surveyed with both EM38 and EM31 instruments as shown in Figures 3.1 and 3.2. Parked cars, trailers and buildings prevented certain parts of the grid from being surveyed. EM38 data were not acquired in the 220N to 540N section of Area C due to the high elevation of fill material over a known ditch (Figure 3.2).

Seismic refraction data were obtained along specific lines across the central and south areas. These lines were spaced approximately 500 feet apart (Figures 1.2 and 3.3).

3.2 DATA ACQUISITION

3.2.1 EM

EM38/31 data were collected on survey lines spaced at 20-foot increments along the completed grid system over each of the six areas. These lines were oriented to maximize data collection in identifying linear ditch/channel features. Along each line, conductivity readings were digitally recorded on an OmniData logger system at the sampling interval of 2.5 feet along the line. Figures 3.1 and 3.2 show the exact location of these sampling stations. EM data were periodically downloaded to a portable field computer for preliminary processing and incorporation into gridding, contouring and plotting software (Surfer for Windows).

The EM data were collected with the Geonics EM38 and EM31 conductivity instruments. These instruments convert the quadrature-phase reading directly into apparent ground conductivity in units of milliSiemens/meter (mS/m), also called millimhos/meter.

3.2.2 Seismic Data Acquisition

Refraction data were acquired along five lines placed over the suspected clay ridge as determined from preliminary contour maps of monitor well geologic logs. Lines were spaced almost equidistant apart at 500-foot intervals approximately perpendicular to the river and the ridge (see Figure 1.2). Line 1 was placed as best as possible along the southern site fence between the river and a jog in the fenceline. Line 2 was positioned just north of the firewater storage pond. Line 3 was placed between the suspected shipyard channel and the exit of the ditch from Area D. Line 4 was located north of a very shallow pond of rainwater. Line 5 was placed just north of Alkali Road as far north as possible without going onto the elevated section of the main east-west ditch. Due to space limitations, Lines 1 and 5 were 420 feet long and Lines 2, 3 and 4 were 480 feet long.

Refraction data were collected as a series of 48 and 96 channel geophone arrays along each line, using a geophone interval of 2.5 feet. Lines consisted of 3.5 to 4 spreads of 48 geophones each. Shots were made at 30-foot intervals along each line in forward, mid-spread and reverse directions. Long overlapping shots were made between spreads to provide continuous deeper coverage along each line (providing 96 channel data).

Each array of 48 geophones (configured in two groups of 24 phones) was connected to the seismograph using spread extension cables and a roll box; this setup permitted selecting different groups of 24 phones as the seismic source was advanced to each refraction shot position (every 30 feet along the line). The 12-pound hammer seismic source was employed at an offset distance of 1.25 feet from the first and last geophone of each 48-channel array for the forward and reverse shots and between phones for the mid-spread shots. This pattern was repeated along the entire line, resulting in symmetrical forward and reverse data sets. Timing between the source and seismograph was established using a trigger switch on the source and a high speed radio link to the seismograph.

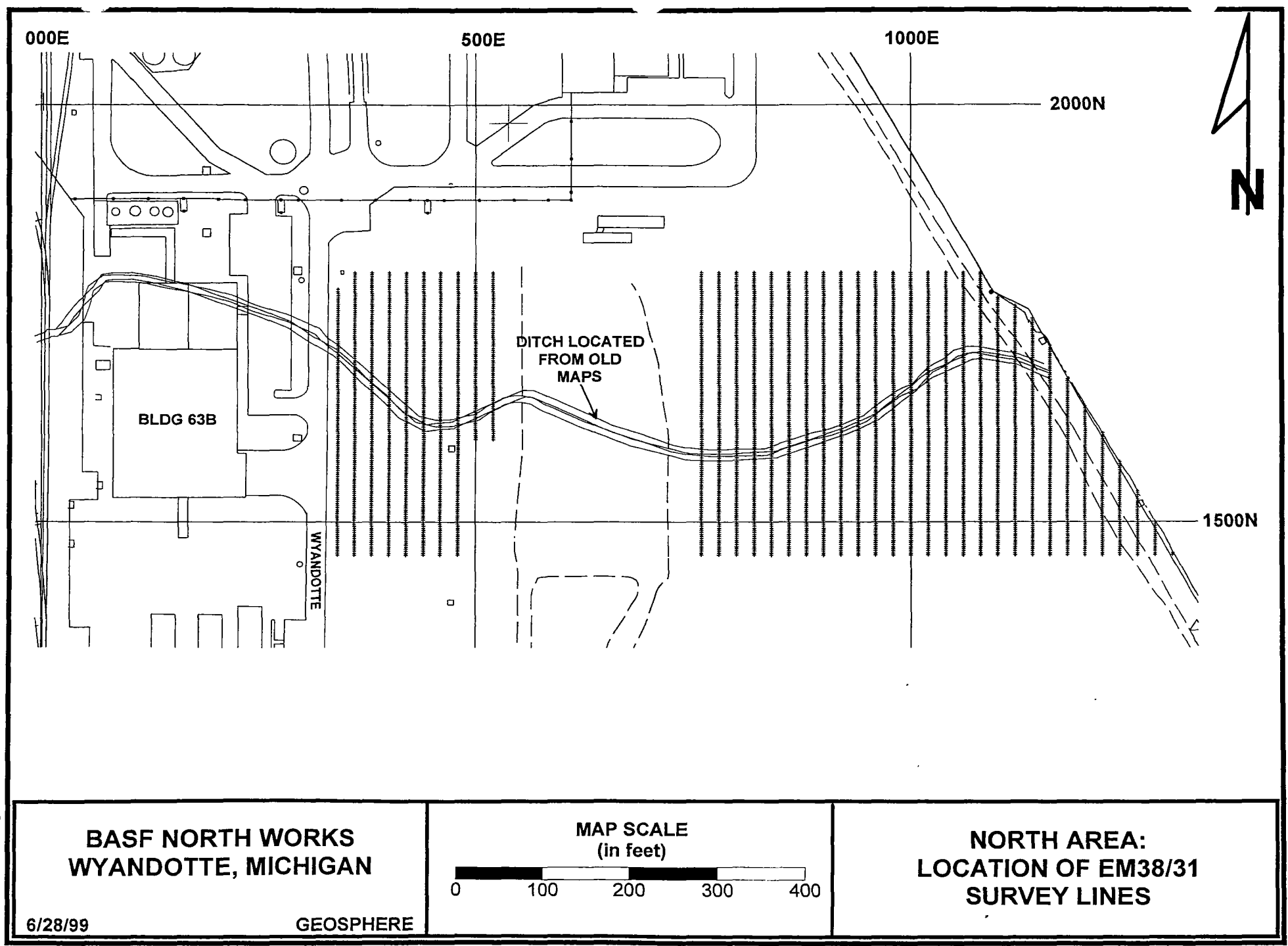
After each shot, the 48 geophone signals (channels) were printed on thermal paper for viewing and quality control. Data were checked for signal strength, proper triggering and any unusual features. Depending on ground conditions and surface (auditory and wind) noise, a number of multiple hits were made, causing the seismic signals to be stacked (added together) within the seismograph. After the operator determined that ample signal strength had been acquired through stacking (usually 5 to 15 times), the 48-channel record was saved into harddrive memory in the seismograph. Then, the source was advanced for the next shot position (30 feet up the line).

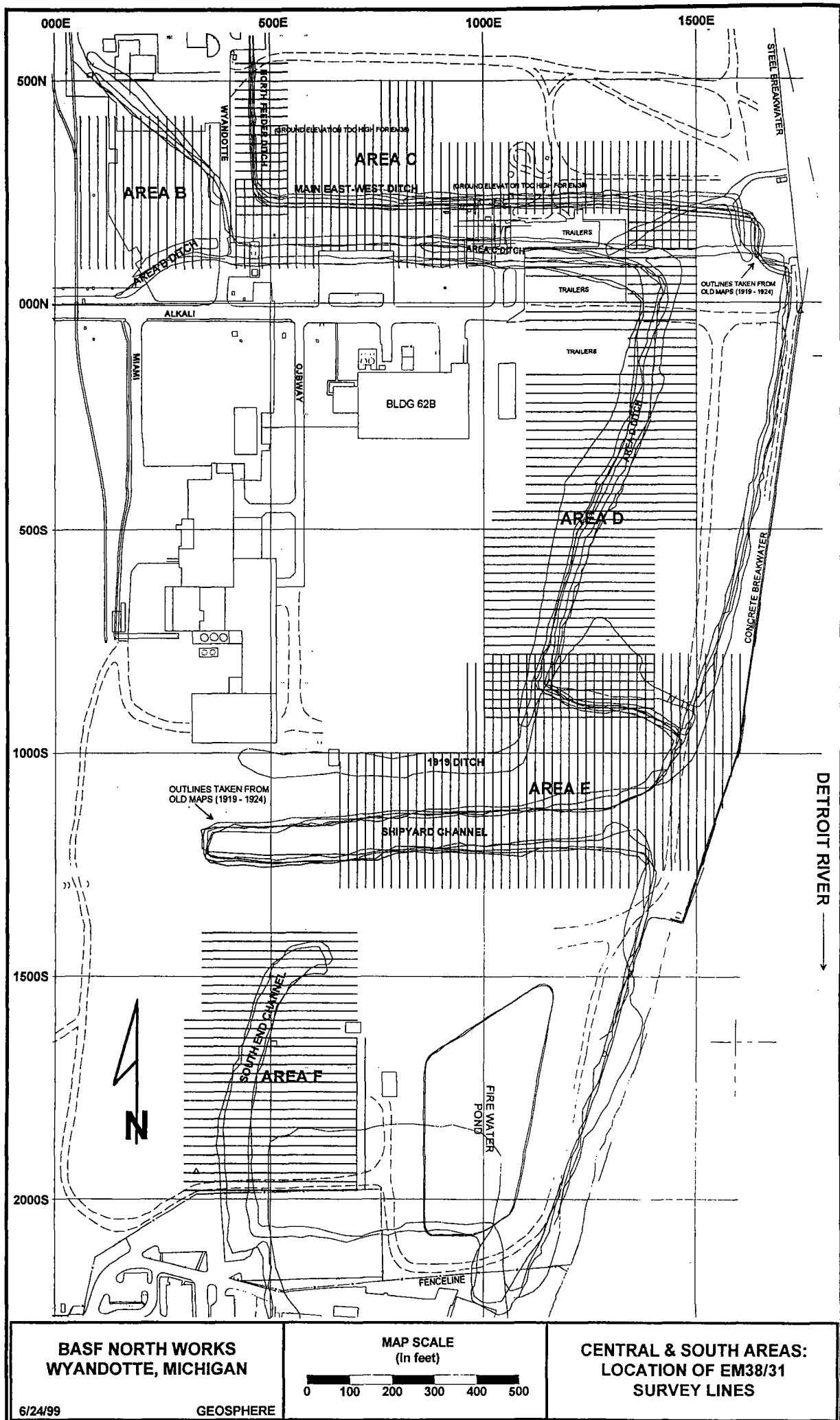
Records saved in the seismograph were downloaded each evening to a computer for preliminary processing. GRM processing employed *ViewSeis* software and included picking the first arrival times for each channel (see Appendix B) and entry of phone and source position geometries and elevation data as well as analysis and calculation of layer velocities and thicknesses. Special filtering procedures were used to reduce/eliminate effects of airwave arrivals.

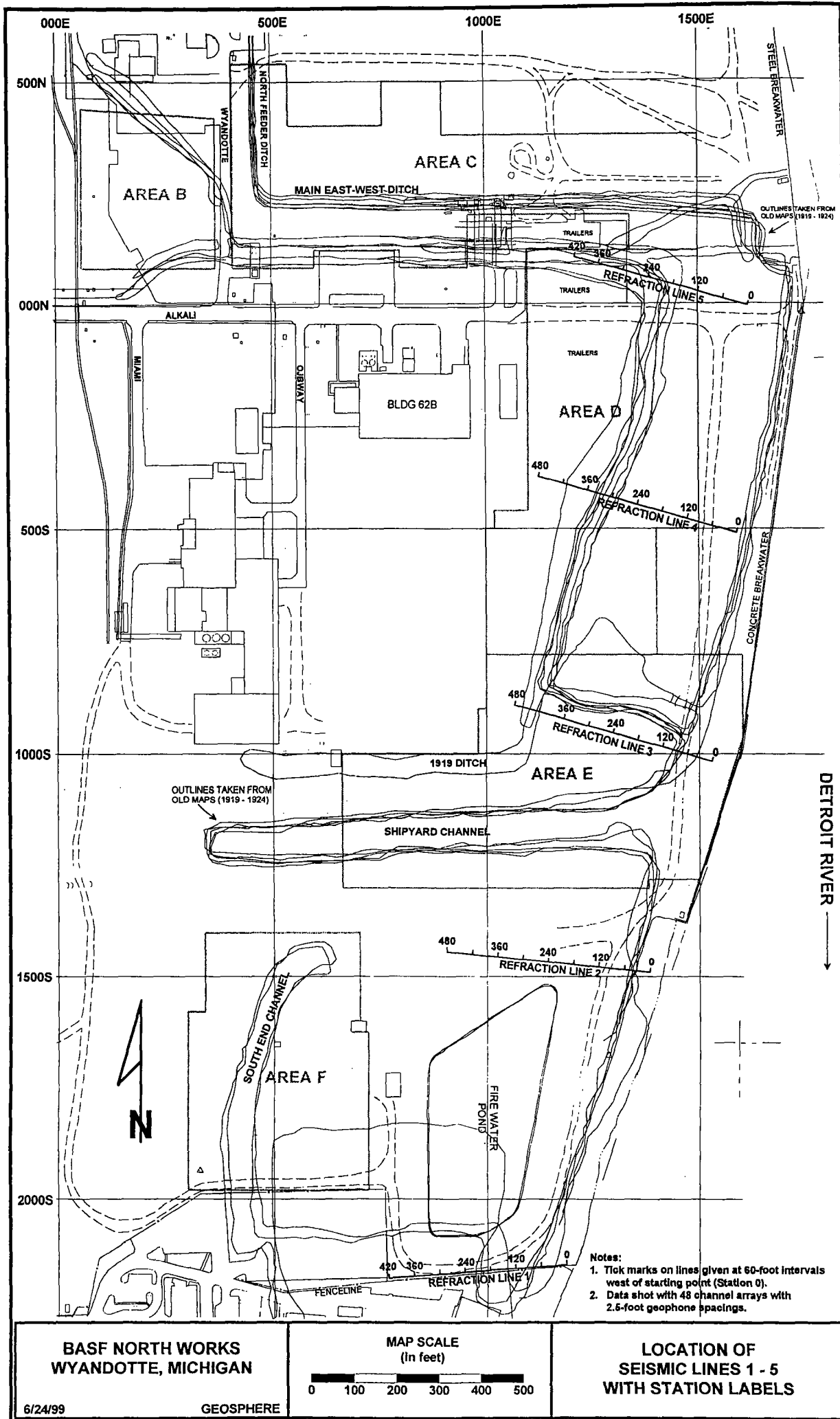
Upon completion of the seismic data collection, a Pentax Auto Level system was used to obtain elevation data at a minimum interval of 30 feet along each line. All elevations are given in feet above mean sea level and were referenced to various monitor wells located throughout the survey area.

3-3

FIGURE 3.1







4 RESULTS AND INTERPRETATION

The final EM38 and EM31 contour maps are provided in Figures 4.1 and 4.2 for the North Area and Figures 4.3 and 4.4 for the Central and South Areas, respectively. These contours are plotted over the BASF CAD map of the North Works site. Interpretations of ditch and channel locations and other features are given on each map. Figures 4.5 through 4.9 present interpreted refraction sections for seismic Lines 1 through 5; BASF grid coordinates are given at 60-foot intervals along each line (see Figure 3.3 for line locations). First-pick plots for the seismic data are given in Appendix B.

4.1 EM DATA PROCESSING AND ANALYSIS

The EM data were preliminarily processed, gridded and contoured in the field using the computer program Surfer for Windows for each of the six survey areas. This provided a means of quality control of the data and provided conductivity information during the field portion of the project. Additional processing in the office included devising a good contour color scheme to maximize the visibility of conductivity changes over the survey area (i.e., dramatize ditch and channel edges) and to combine the overlapping data sets into one contour map.

Analysis was made by closely reviewing contour maps for each area and noting any trends that correlated to the suspected ditch/channel locations on the map. The suspected locations of ditches (as determined from historical maps) were found to correlate with linear patterns of conductivity lows surrounded by high conductivity values found over most areas (with one exception). This fact is thought to be caused by the use of relatively clean fill in closing in the ditches, thus resulting in a low conductivity pattern contrasted to the high surrounding values. Edges of the former channels in the southern end of site did not show an obvious correlation to EM contours as the ditches, but did show a relationship to EM lows on a more subtle level at sporadic locations along their edges.

4.2 EM INTERPRETATION

4.2.1 North Area (Area A) (from Gridline 1460N to Gridline 1800N)

Information taken from old maps indicate that a drainage ditch passed through the North Area in somewhat of a zigzag pattern near the 1500N gridline from a point west of Wyandotte Road to the Detroit River breakwater in the east. Due to existing buildings, trailers and parked cars, EM coverage was made in two parts to cover the suspected ditch path: one part near Wyandotte Road and a second larger part near the Detroit River.

Analysis of Figures 4.1 (EM38 contours) and 4.2 (EM31 contours) reveals that background conductivities lie in the 10 to 200 milliSiemens/meter (mS/m) range over most of the survey grid near the river. Conductivities increase greatly in localized portions of the western zone near Wyandotte Road. A notable linear conductivity high is also observed in the river area oriented in a southwest to northeast direction. Because of the straightness of this feature and its high conductivity level (linear patterns of lower conductivity were found to be associated with ditches -- observed in Areas B, C, and D), this feature is interpreted as a buried culvert probably composed of steel or iron rebar in concrete. Subtle patterns in both EM38 and EM31 maps suggest that the filled ditch lies some 20-30 feet south of the outline taken from old maps. The eastern portion of this feature coincides with the culvert feature, suggesting that the culvert may have been laid in the eastern part of the ditch.

4.2.2 Central and South Area (Areas B, C, D, E, and F)

Ditch outlines from the old maps show that a main east-west ditch ran from Area B through Area C to the

river. Just east of Wyandotte Road, a northern feeder ditch joined the Main Ditch. South of the Main Ditch was another east-west ditch (called Ditch B, Ditch C and Ditch D in various segments along its path); near gridline 1420E, the ditch turned south for 900 feet before it turned back to the east to the river.

Figures 4.3 and 4.4 show extremely high conductivity values over much of the survey grid. However, linear trends of lower conductivity correlate very closely with ditch patterns taken from the old maps; this correlation is undisputable in survey Areas B and C for both the Main Ditch and Ditch B and C segments. It also appears that a short ditch (B-Bypass, Figures 4.3 and 4.4) interconnected the two east-west ditches immediately west of Wyandotte Road; this likely permitted re-routing drainage during cleaning or reconstruction of the eastern parts of the ditch system. A similar interconnecting ditch (C-Bypass) is found at the eastern end of the two ditches near gridline 1300E before Ditch C turns south to become Ditch D.

The route of Ditch D is not as obvious as Ditch segments B and C, but crucial features and turns are recognizable and the interpretation from the old maps appears accurate. A linear, north-south trend in EM values is also observed along gridline 1300E; this feature (labeled Unknown Feature in Figures 4.3 and 4.4) may have been a temporary ditch that connected Ditch C and D, bypassing the turn to the south at gridline 1420E. It has the same width (30 feet) as Ditch segments C and D. Near gridline 850S, Ditch D turns back to the east toward the river. This zone of the grid has extremely high conductivity values and drastic swings from negative values to over 800 mS/m. Consistently high values are attributable to the alkali plant that once stood in this area; strong negative EM31 values and very high EM38 values over this segment of the ditch are representative of extensive pilings and steel reenforced concrete pilings placed in the old ditch bed as part of the old plant. (Steel rebar in the pilings are longer than the EM38 intercoil spacing - yielding high values, and less than the EM31 intercoil spacing - yielding negative values.) Farther to the east at the interpreted old breakwater, these conductivity features may represent concrete pilings of old wharves that may have lined the former river edge where the ditch emptied into the river. Linear east-west features seen in Figure 4.3 near 550S and 800S are interpreted as a series of concrete pilings that likely supported the former alkali plant and ancillary buildings.

The feature labeled as the 1919 Ditch (gridline 1025S) correlates to a linear trend of high conductivity values, unlike all the other ditch/channel features. This linear pattern is also unusual in that it was only found on the 1919 map, whereas all other ditches/channels were located on two or more maps of the area.

Low conductivity patterns in Area E correlate closely with the old shipyard channel which is some 80 to 90 feet wide. The northeastern portion of this channel merges with the interpreted old river breakwater/wharf area described above. A 130-foot long, low conductivity feature found in the center of the channel (coordinates 1000E/1180S) may represent a sunken iron barge.

Extreme conductivity values are again found in Area F, particularly evident in the EM38 contour map (Figure 4.3). A very strong linear pattern of very high values runs through the southeastern corner of Area F, oriented in a southwest to northeast direction. It appears to lie in an approximate parallel relationship with an old road that extended up to the old firewater pump house. It may represent a pattern of high-salt fill dumped from the road or a buried utility that released salt-rich water into the subsurface. The outline of the South End shipyard channel is not clearly evident in the geophysical maps as others farther north, but certain crucial lows and interpreted (negative) pilings line up with the shape and size of the old map outlines.

4.3 SEISMIC RESULTS

Line 1: The refraction section for Line 1 (Figure 4.5) was obtained across the southeastern property line of the North Works site, immediately south of the firewater pond. Velocity analysis of the first pick data shows two shallow layers. These layers are interpreted as:

- 1) surficial fill that was placed as a cover over the site (988 ft/sec)
- 2) a second layer of hard fill and natural clay sediments (4,282 ft/sec).

In general, seismic calculations show that the clay surface lies approximately 8 to 11 feet below the surficial fill layer. Due to higher velocity fill near the river, the expected dip (dashed line 180W to 0W) in the clay surface towards the east was not detected. A rise in the interpreted clay surface is evident between Stations 360W and 340W and between 120W and 90W, peaking at approximately elevation 566. Either one could represent the ridge.

Line 2: Line 2 (Figure 4.6) acquired north of the firepond shows a similar shallow section:

- 1) surficial fill (1,237 ft/sec)
- 2) a second layer interpreted as clay sediment (4,167 ft/sec).

The overall shape of the clay surface appears to coincide with preliminary clay maps derived from well logs. However, the seismic elevation values seem to be slightly higher (3-5 feet) than from the well logs; this might be due to differences in the two methods or caused by a compact layer just above the clay. Based on the seismic data, the ridge crest seems to lie at Station 120W.

Line 3: Line 3 (Figure 4.7) acquired near gridline 1000S shows:

- 1) surficial fill (2,014 ft/sec)
- 2) a second layer (4,123 ft/sec).

Mapping of the clay ridge is obscured by large segments of hard fill (and/or concrete) and cuts in the clay (likely manmade). A dip in the second layer at the western end of the line is interpreted as the bottom of the 1919 Ditch and a large dip at the eastern end is interpreted as excavation (dredging) for the old shipyard channel entrance. A peak in the second layer at Station 145W is believed to be caused by concrete and heavy fill and is not representative of the clay ridge.

Line 4: Line 4 (Figure 4.8) acquired near gridline 500S shows:

- 1) surficial fill (1,341 ft/sec)
- 2) a second layer (5,911 ft/sec).

Mapping of the clay ridge is again obscured by large segments of concrete/hard fill (Figure B-4, Appendix B). Ditch D was not detected in the vicinity of Station 320W; however, a steep dip of the second layer's surface to the east is interpreted as the clay surface eroded by the river in past times. A peak in the second layer between Stations 160W and 120W is not believed to be representative of the clay ridge, but a dip at Station 240W is likely a real dip in the clay surface.

Line 5: Line 5 (Figure 4.9) acquired near gridline 000N shows:

- 1) surficial fill (1,462 ft/sec)
- 2) a second layer (5,053 ft/sec).

Mapping of the clay ridge is obscured by cuts in the clay and layers of hard fill/concrete. A large dip in the second layer at the western end of the line probably represents the excavation of the clay surface for the channel of Ditch C just before it turns south. Large amounts of concrete and fill are interpreted at the eastern end of the line, preventing detection of the dipping clay surface (dashed line). A second layer peak at Station 143W might represent the clay, but is likely caused by high velocity fill.

Seismic Summary: Information from these five lines (in conjunction with the EM data) indicate that subsurface conditions in the central part of the study area are not indicative of a simple system of sand over clay. The clay ridge has very likely been cut and shaped by ditch/channel excavations and numerous foundations/pilings of the former alkali plant that once stood in this area. These foundations appear to be widespread and probably are in contact with or occupy a sizeable portion of the original clay ridge surface.

Electrical Methods

Electrical properties are among the most useful geophysical parameters in characterizing earth materials. Variations in electrical conductivity (or its inverse, resistivity) typically correlate with variations in water saturation, fluid conductivity, porosity, permeability, and the presence of metal. Depending on the particular site, these variations may be used to locate contaminant plumes, salt water intrusion, stratigraphic units, sinkholes, fractures, buried drums and tanks, and any other feature whose electrical properties contrast with the surrounding earth.

Ground conductivity can be measured either directly, using the galvanic resistivity method, or inductively, using electromagnetic induction (EM). Because EM requires no direct contact with the ground surface, data can be acquired more quickly than with resistivity. Resistivity, however, can provide better vertical resolution and is generally less sensitive to cultural noise such as fences, buildings and overhead powerlines.

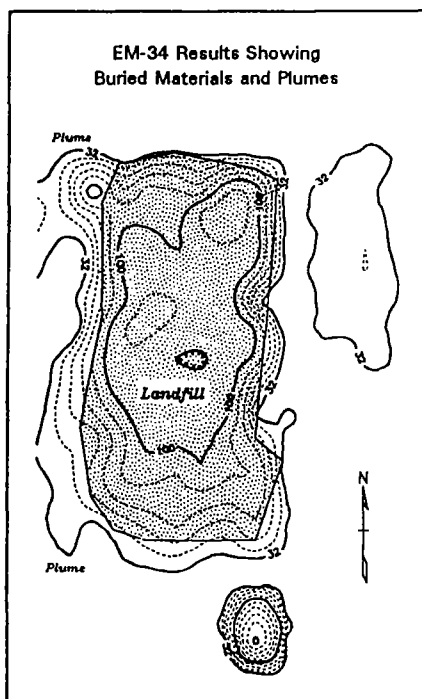
Electromagnetic Induction

The EM technique measures the electrical properties of materials contained in the subsurface including soil, rock, ground water, and any buried objects. An alternating current in the EM transmitter coil creates a magnetic field which induces electrical current loops within the ground; the current loops, in turn, create a secondary magnetic field. Both the primary magnetic field (produced by the transmitter coil) and the secondary field induce a corresponding alternating current in the EM receiver coil. After compensating for the primary field (which can be computed from the relative positions and orientations of the coils), both the magnitude and relative phase of the secondary field can be measured. These can be converted to components in-phase and 90° out of phase with the transmitted field. The out of phase (or quadrature-phase) component, using certain simplifying assumptions, can be converted to a measure of apparent ground conductivity. The in-phase component, while generally not responsive to changes in bulk conductivity, is especially responsive to discrete, highly-conductive bodies such as metal objects. The apparent conductivity measurement is the average conductivity of one or more layers in the ground in the proximity of the instrument, to a depth of investigation dependent on the coil spacing, orientation, operating frequency of the instrument, and the individual conductivity of each ground layer.

Applications of Electrical Methods

EM and resistivity can be applied to a wide variety of problems encountered in environmental, ground water, geotechnical, and archaeological work, including:

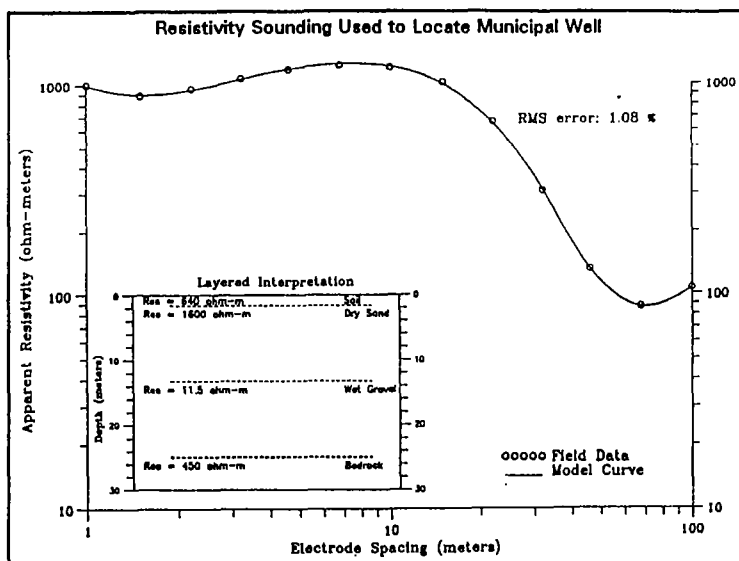
- Location of buried drums, tanks, trenches, and utilities
- Location of landfills and bulk buried materials
- Delineation of contaminant plumes
- Depth of water table and aquifer identification and mapping
- Continuity of stratigraphic interfaces such as clay layers
- Mapping of faults and fractures
- Location of karst features



Galvanic Resistivity

Using an older technique called resistivity, electrical conductivity (resistivity) can also be measured by applying a current directly into the ground through a pair of electrodes. A voltage difference measured across a second electrode pair provides the necessary information to calculate the apparent earth resistivity (the inverse of apparent conductivity). The depth of investigation depends on the electrode separation and geometry, with greater electrode separations yielding bulk resistivity measurements to greater depths.

The EM and resistivity methods are used in two different modes: **profiling** and **sounding**. Profiling is used to detect lateral variations across a site by taking a series of readings along a line using a fixed configuration of coils or electrodes. (EM is typically used in the profile mode). Soundings are used to estimate vertical variations in electrical conductivity or resistivity. A resistivity sounding is made by taking many readings with increasing electrode separations at a single location. An EM sounding is obtained by taking readings at a single location with several coil spacings and coil orientations. The data are then inverted to produce a model of conductivity (resistivity) variations with depth. Due to the greater number of readings possible, resistivity soundings provide better vertical resolution than EM soundings. Profiles and soundings may be obtained simultaneously to yield a 3-dimensional model.



While both EM and resistivity measure apparent ground conductivity, their response to certain kinds of anomalies differs markedly. EM is very sensitive to highly conductive media, so a thin, high conductivity layer may dominate over much thicker, low conductivity layers. Also, if conductivities are very high, the measurements become non-linear and eventually turn negative. The resistivity method is less sensitive to thin, high conductivity layers and can measure even the lowest and highest apparent conductivities.

Field Procedures

For EM work, Geosphere uses the Geonics EM-31DL, EM-34XL, and EM-38 instruments. All instruments read apparent conductivity directly in units of millimhos/meter. The one-man portable

EM-31 has a fixed coil separation with an investigative depth of 20 feet. The EM-34 requires a crew of two and has three coil separations, with investigative depths from 25 to 200 feet. Geosphere has rigged a 4x4 truck to acquire continuous data over large areas using the 10 meter configuration; this method has proved valuable in locating and mapping deep karst features, faults, and buried sand channels. The EM-38 measures shallow soil conductivities to depths of 3 to 6 feet. With all three instruments, data are acquired either on analog strip charts or digitally which are downloaded to a field computer. The in-phase component of these EM systems also provide valuable data concerning the location of buried metal objects and pipes. Other EM systems available include the EM-39 borehole induction logger.

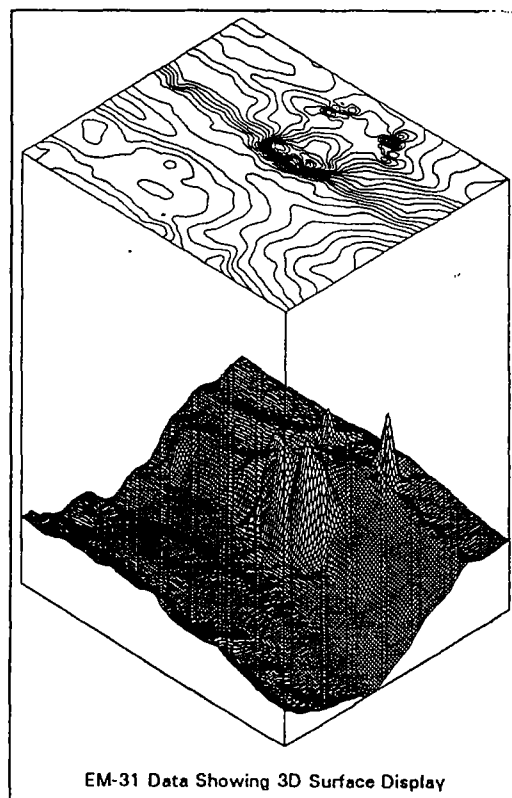
Resistivity surveys usually employ a Wenner electrode array (four co-linear, equally-spaced electrodes) and an ABEM Terrameter earth resistivity meter. The instrument reading in ohms (applied current divided into the measured voltage difference) is converted to apparent resistivity (in ohm-meters) by means of a geometric factor determined for the electrode array. For soundings, the inter-electrode spacings are varied approximately logarithmically (six readings per decade) over a range determined for the particular site.

Data Processing

Conductivity profile data are often computer gridded, producing a data set which can be contoured or displayed as a 3-dimensional surface. Resistivity sounding data are inverted, using in-house computer software, producing a model of discrete layers, each of constant resistivity (or conductivity). The inversion routine computes theoretical curves based on a trial model and adjusts the model parameters iteratively until it achieves a satisfactory match with the field data. Geologic interpretation of electrical conductivity data involves matching observed anomalies with characteristic responses to known features. Constraining information, such as well data, outcrops, or other geophysical data, is very useful in producing a comprehensive, coordinated interpretation.

Summary

Electrical geophysical techniques are extremely useful in a wide variety of situations. For example, the EM method can quickly provide very high density information which cannot otherwise be obtained in critical areas. Geosphere is among the leaders nationwide in applying electrical methods to environmental investigations, hazardous waste sites, ground water exploration, karst features, archaeology, and other disciplines.



Seismic Exploration

"Seeing" with sound is a familiar concept. Bats and submarines do it and so does a blind man with a cane. In total darkness we can sense whether we are in a closed or open space by the echoes from our footsteps.

Seismic exploration, in principle, is nothing more than a mechanized version of the blind person and his cane. In place of the tapping cane we have a hammer blow on the ground, or an explosion in a shallow hole, to generate sound waves. And we "listen" with geophones, spring-mounted electric coils moving within a magnetic field, which generate electric currents in response to ground motion. Careful analysis of the motion can tell us whether it is a direct surface-borne wave, one reflected from some subsurface geologic interface, or a wave refracted along the top of an interface. Each of these waves tells us something about the subsurface.

Seismic Reflection

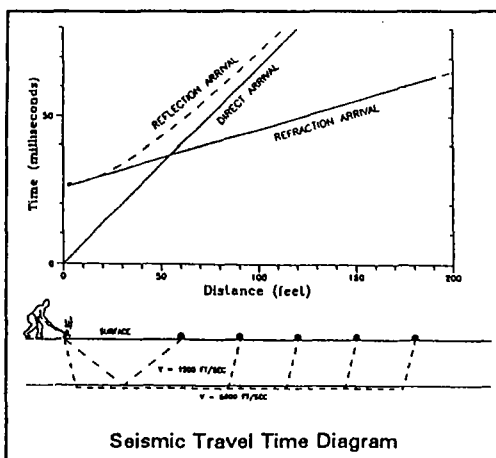
Reflections of sound waves from the subsurface arrive at the geophones some measurable time after the source pulse. If we know the speed of sound in the earth and the geometry of the wave path, we can convert that seismic travel time to depth. By measuring the arrival time at successive surface locations we can produce a profile, or cross-section of seismic travel times. A simple concept.

In practice, the speed of sound in the earth varies enormously. Dry, unconsolidated sand might carry sound waves at 800 feet per second (fps) or less. At the other extreme, unfractured granite might have a velocity in excess of 20,000 fps. And the more layers between the surface and the layer of interest, the more complicated the velocity picture. Various methods are used to estimate subsurface velocities, including refraction analysis, borehole geophysical measurements, estimates from known lithologic properties, and analysis of reflection times at increasing offsets. Generally, a combination of velocity estimation methods will give the best results.

Seismic Refraction

When a sound wave crosses an interface between layers of two different velocities, the wave is refracted. That is, the angle of the wave leaving the interface will be altered from the incident angle, depending on the relative velocities. Going from a low-velocity layer to a high-velocity layer, a wave at a particular incident angle (the "critical angle") will be refracted along the upper surface of the lower layer. As it travels, the refracted wave spawns upgoing waves in the upper layer, which impinge on the surface geophones.

Sound moves faster in the lower layer than the upper, so at some point, the wave refracted along that surface will overtake the direct wave. This refracted wave is then the first arrival at all subsequent geophones, at least until it is in turn overtaken by a deeper, faster refraction. The difference in travel time of this wave arrival between geophones



depends on the velocity of the lower layer. If that layer is plane and level, the refraction arrivals form a straight line whose slope corresponds directly to that velocity. The point at which the refraction overtakes the direct arrival is known as the "critical distance", and can be used to estimate the depth to the refracting surface.

Field Procedures

Seismic field acquisition involves three basic elements:

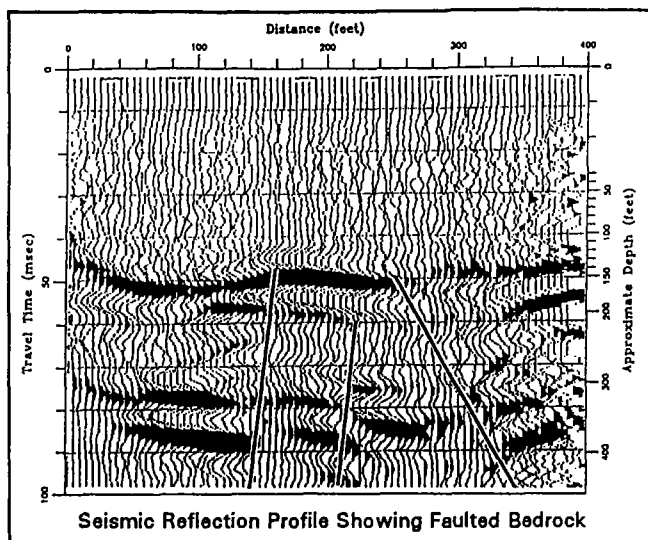
- a source of acoustic energy
- seismic receivers, or geophones
- a seismograph to record the data

The choice of seismic source depends on the needs of the particular survey. For deeper work, a powerful source, such as the "Elastic Wave

Applications of Seismic Methods

Seismic reflection and refraction have numerous potential applications to a variety of environmental and geotechnical problems, including:

- Depth and characterization of bed-rock surface
- Buried channel definition
- Depth of water table
- Depth and continuity of stratigraphic interfaces
- Rippability determination
- Mapping of faults and other structural features
- Location of karst features



depends on the nature of the survey. For seismic reflection, the relative source and geophone positions are usually held constant, the entire 24-geophone array being moved along with the shot. (The logistical difficulties of this are eased by using a "roll switch", which selects 24 geophones from an overall spread of 48.) Refraction work requires shots at opposite ends of the spread, with additional shot locations depending on the particular needs of the job.

Data Processing

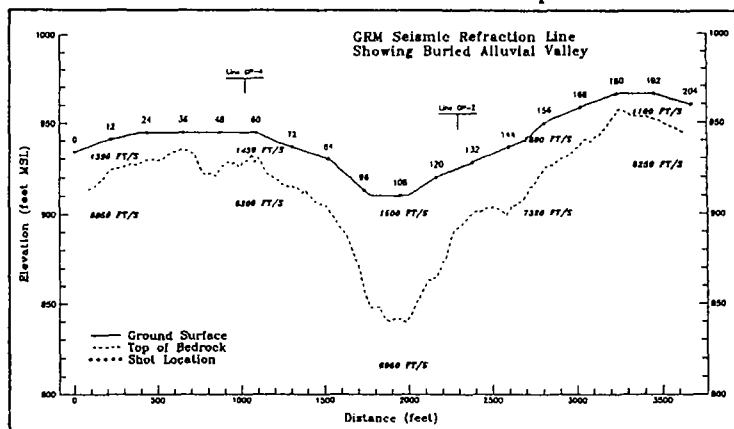
A seismic reflection section is, in principle, a series of seismic traces recorded by a geophone at the same location as the shot. Each trace must be time-corrected to allow for the source-geophone offset, the correction depending on the layer velocities. If the correction is accurate, a given reflection is moved up the trace to the position it would have were the source and receiver coincident. Using the field procedure described above, 12 individual traces, of various source-receiver offsets, will have a common midpoint. These 12 traces, after correction, are summed to produce one common depth point, or 12-fold CDP trace. The resulting summed traces are then displayed as a single seismic cross-section.

A seismic trace may contain as many as 4000 individual samples. With each shot generating 24 traces, a typical seismic line will contain several million samples. Geosphere processes these data with the "Eavesdropper" package, developed by the Kansas Geological Survey for 386/486 PC computers. Specialized reflection data can also be processed using common offset software developed by the Canadian Geologic Survey. Augmented by several programs developed by Geosphere, we now have a seismic reflection processing system tailored to the unique problems encountered in high-resolution seismic work. We believe this system to be unmatched in the industry.

Seismic refraction data can be interpreted in several ways. The simplest approaches assume a series of plane, dipping layers. While effective in many instances, this method is not suited to irregular or undulating layers. The Generalized Reciprocal Method (GRM) goes beyond the plane-layer assumption, producing a profile which allows for irregularities in the refracting surface. When possible, we combine GRM results with reflection data to produce the most comprehensive seismic interpretation available.

Summary

Seismic exploration is a powerful geophysical technique. The same principles which have achieved unparalleled success in the petroleum industry can also enhance environmental and hazardous waste site investigations, ground water exploration, geotechnical engineering, archaeology, and mining exploration. At Geosphere, we intend to continue providing the most effective, state-of-the art seismic exploration available.



4-4

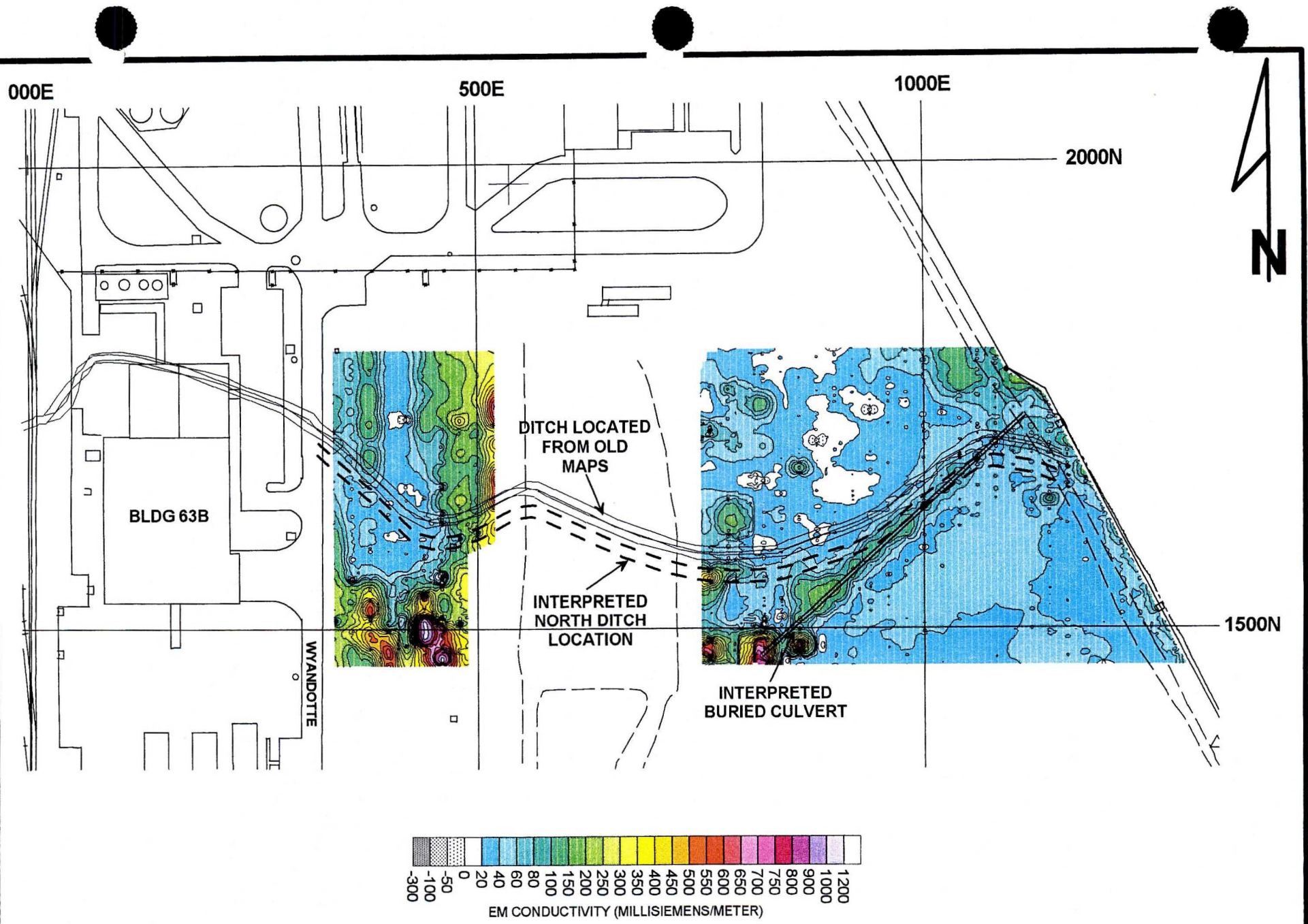
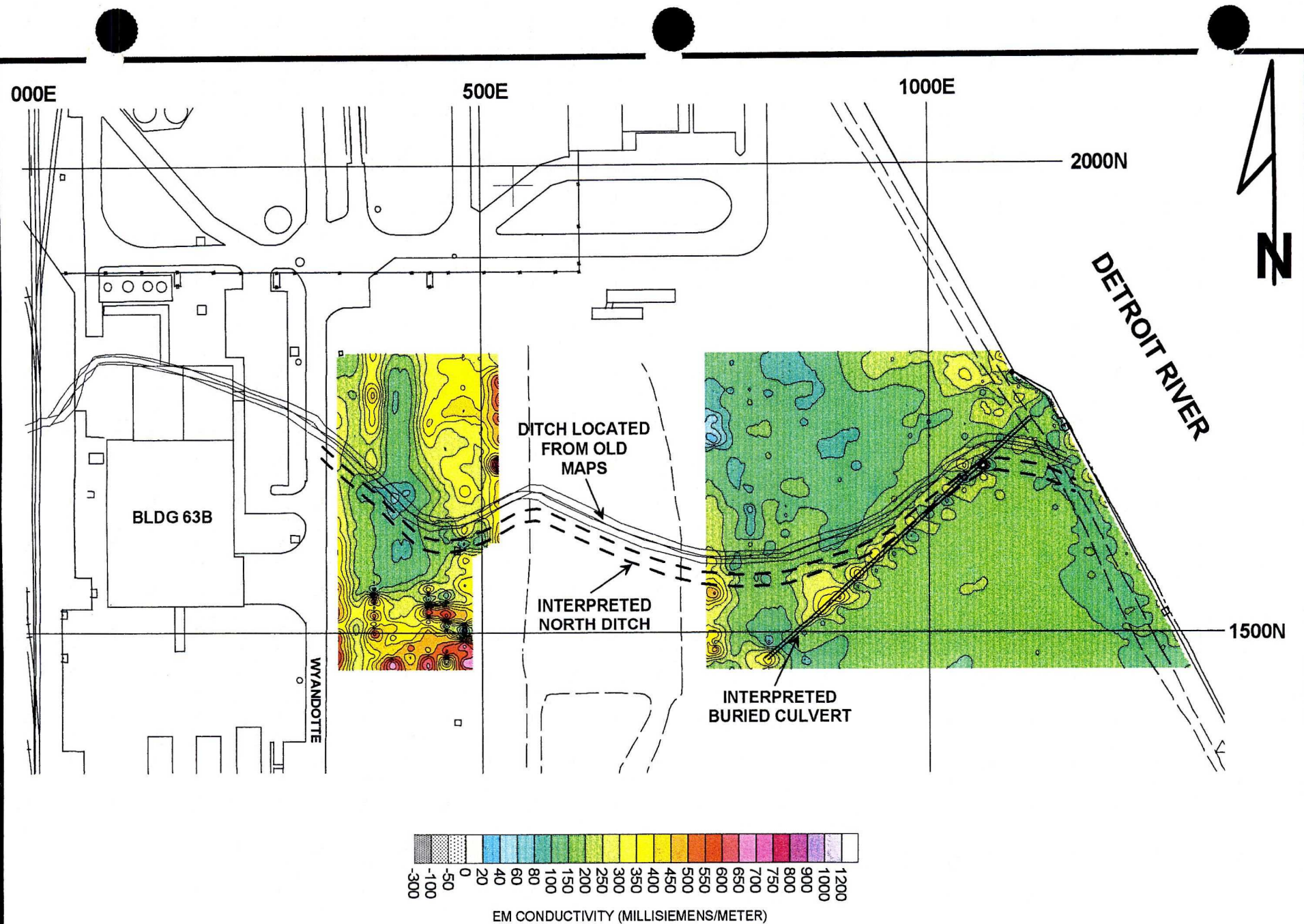


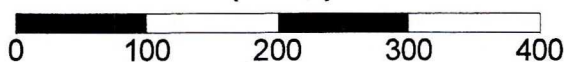
FIGURE 4.1

<p>BASF NORTH WORKS WYANDOTTE, MICHIGAN</p> <p>6/28/99</p> <p>GEOSPHERE</p>	<p>MAP SCALE (in feet)</p> <p>0 100 200 300 400</p>	<p>NORTH AREA: EM38 CONDUCTIVITY CONTOUR MAP</p>
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**BASF NORTH WORKS
WYANDOTTE, MICHIGAN**

**MAP SCALE
(in feet)**



**NORTH AREA:
EM31 CONDUCTIVITY
CONTOUR MAP**

6/28/99

GEOSPHERE

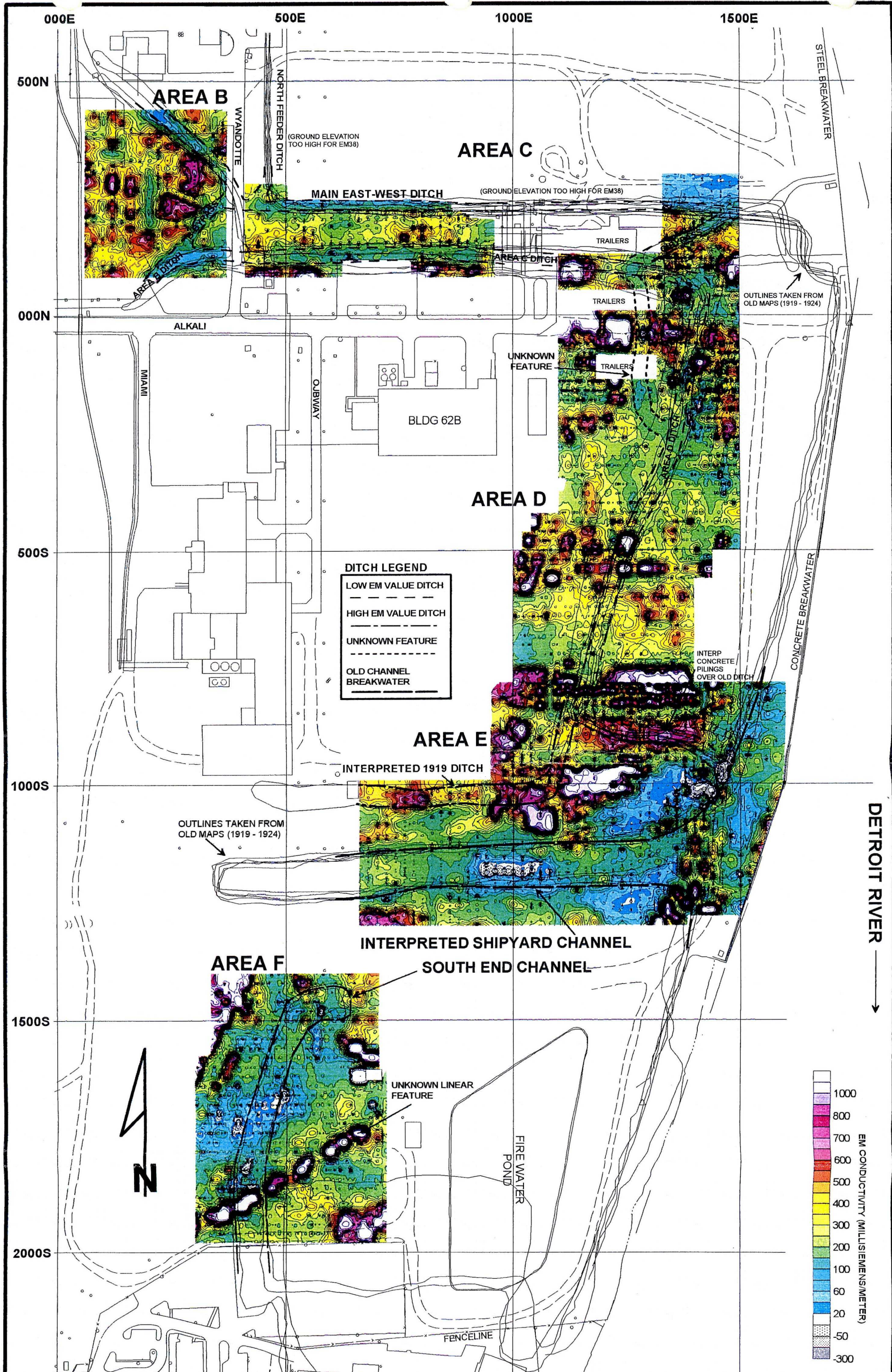
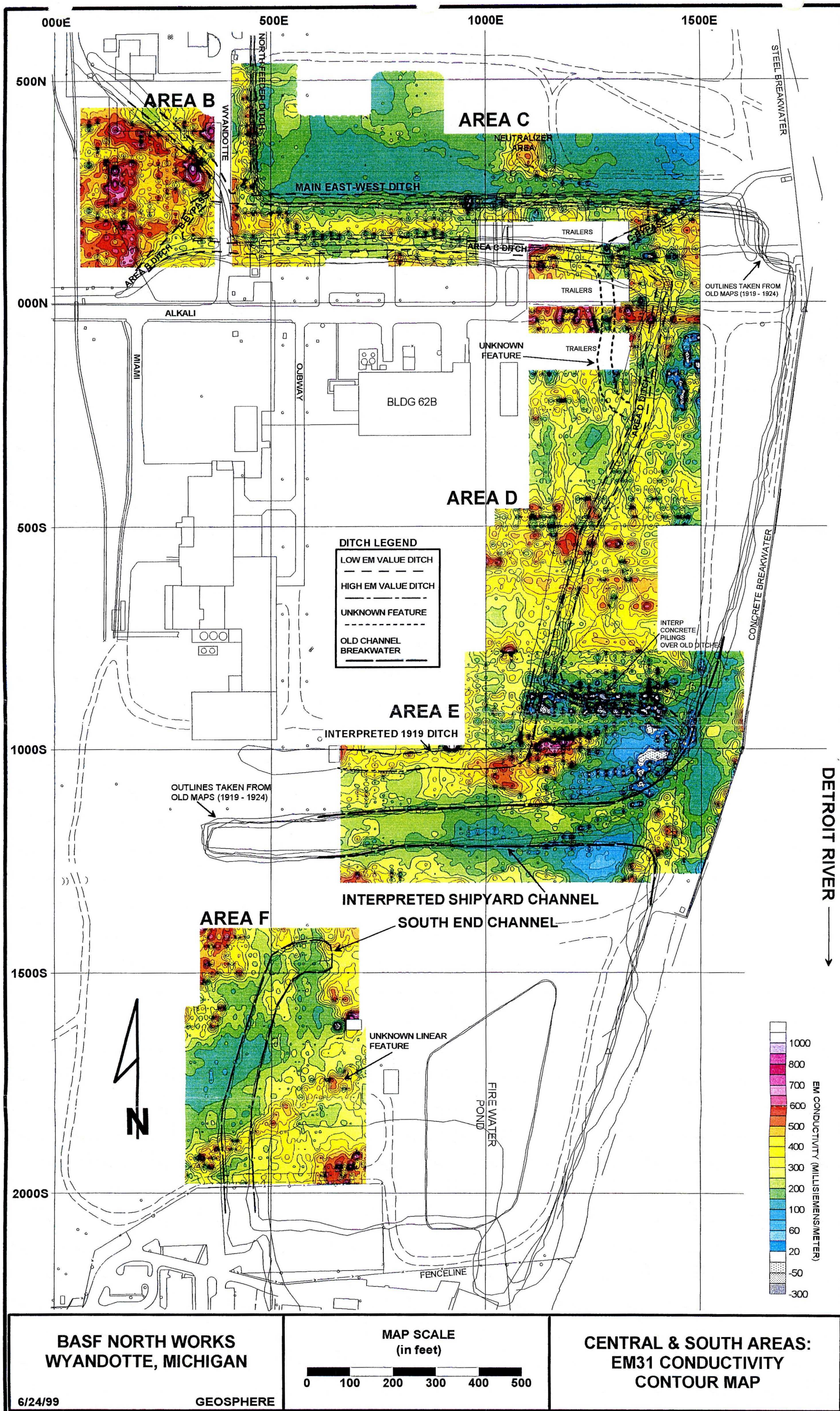


FIGURE 4.3

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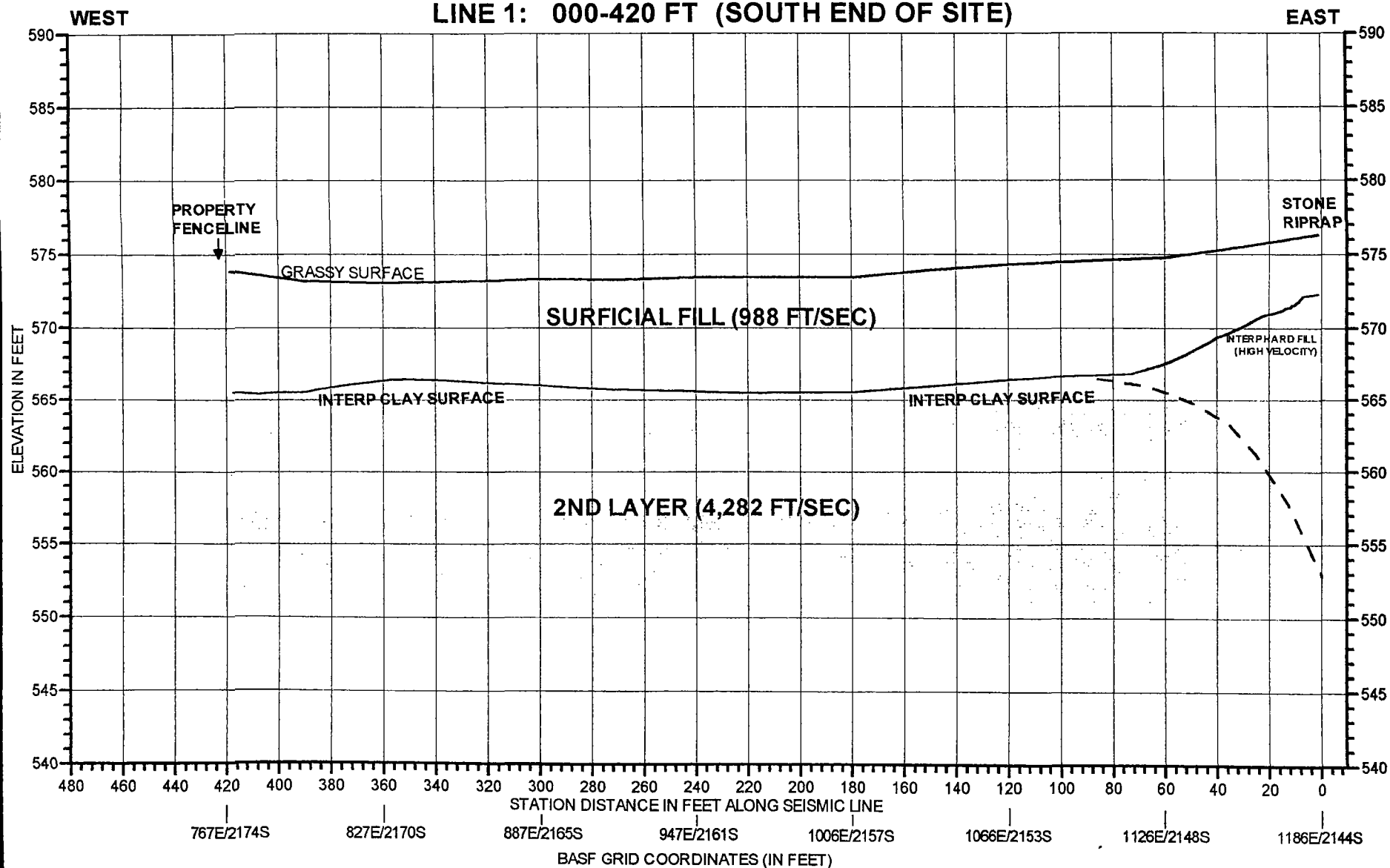
GEOSPHERE

FIGURE 4.4

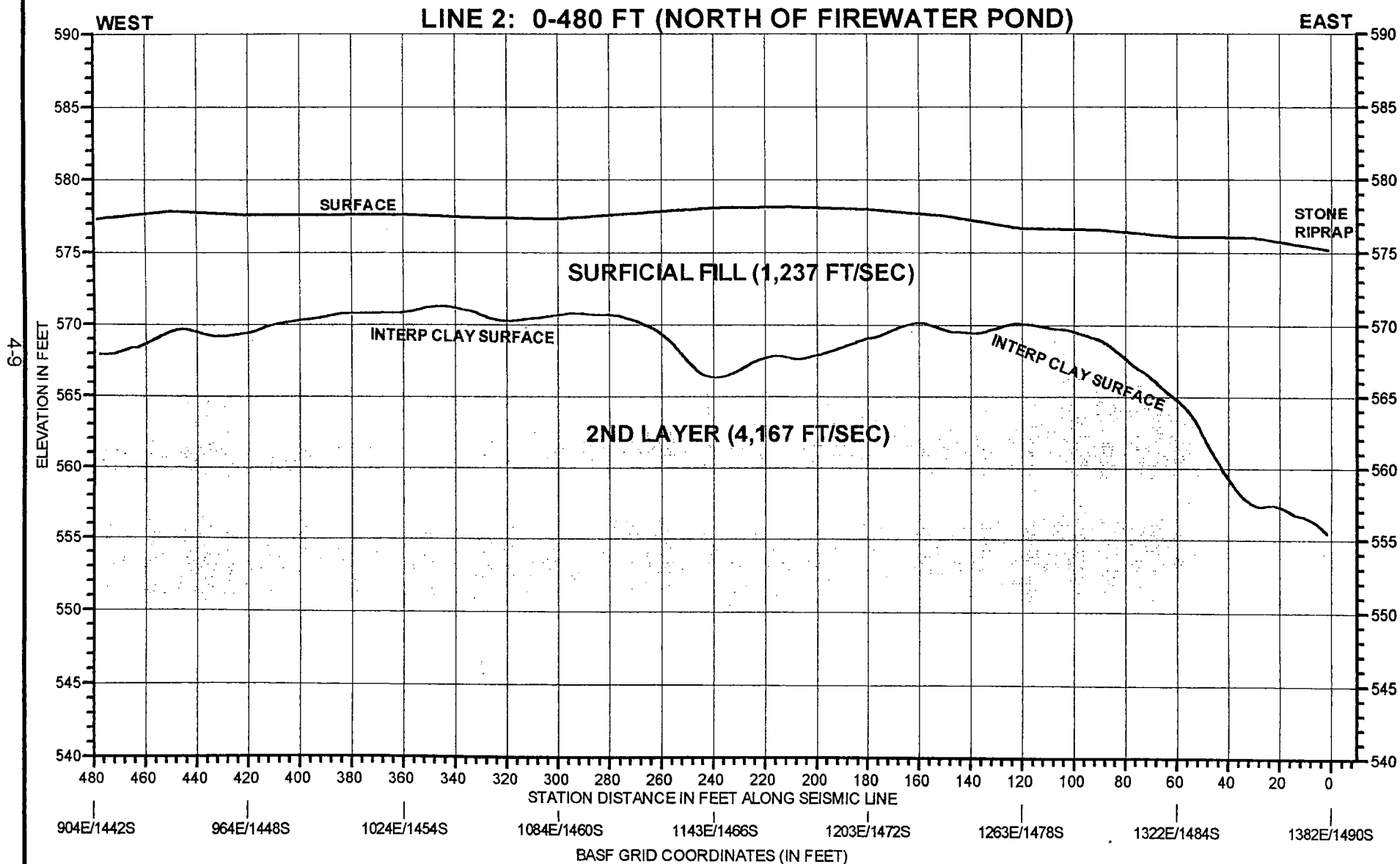


BASF NORTH WORKS: SEISMIC REFRACTION LINE 1 INTERPRETED SEISMIC/GEOLOGIC SECTION

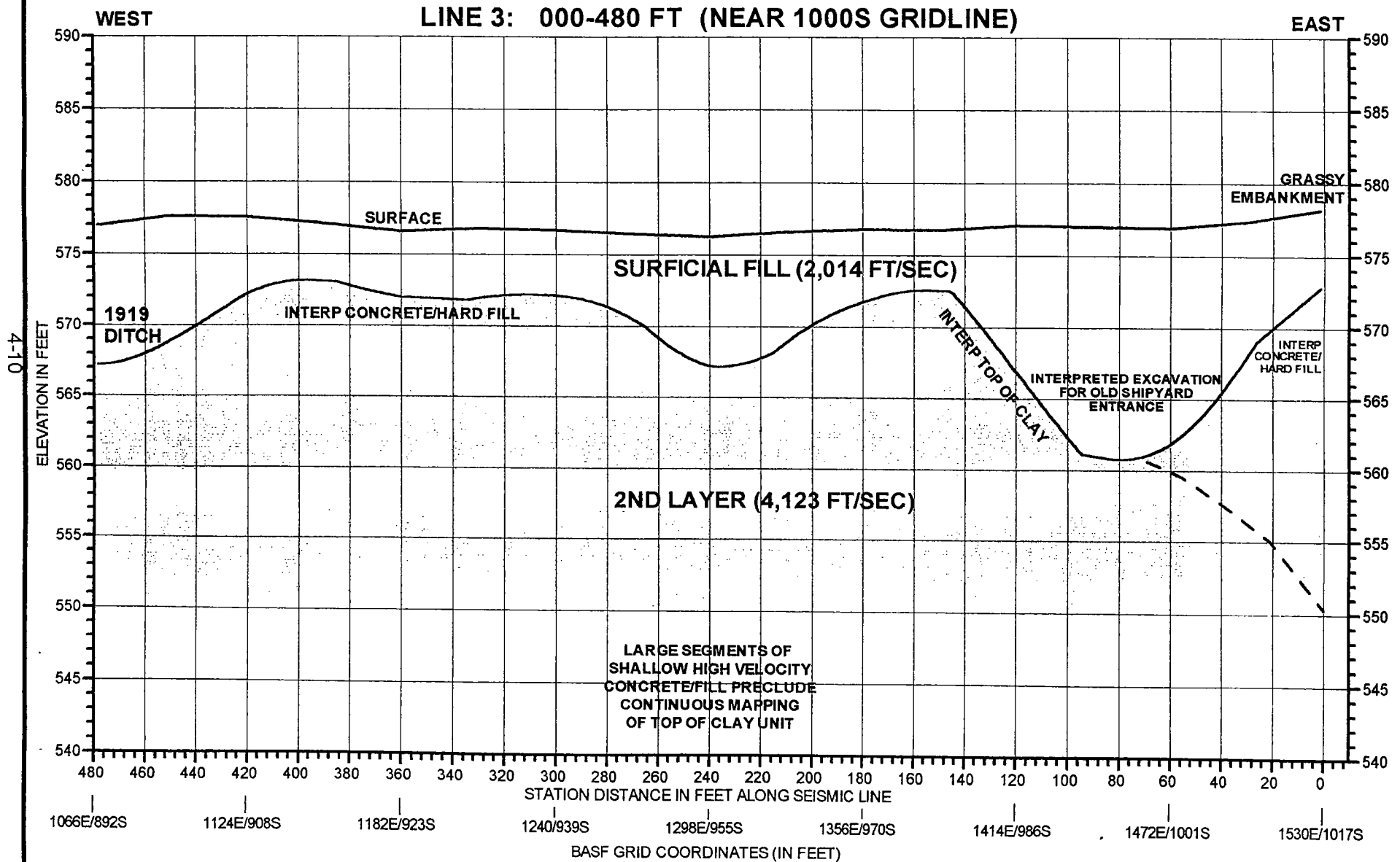
LINE 1: 000-420 FT (SOUTH END OF SITE)



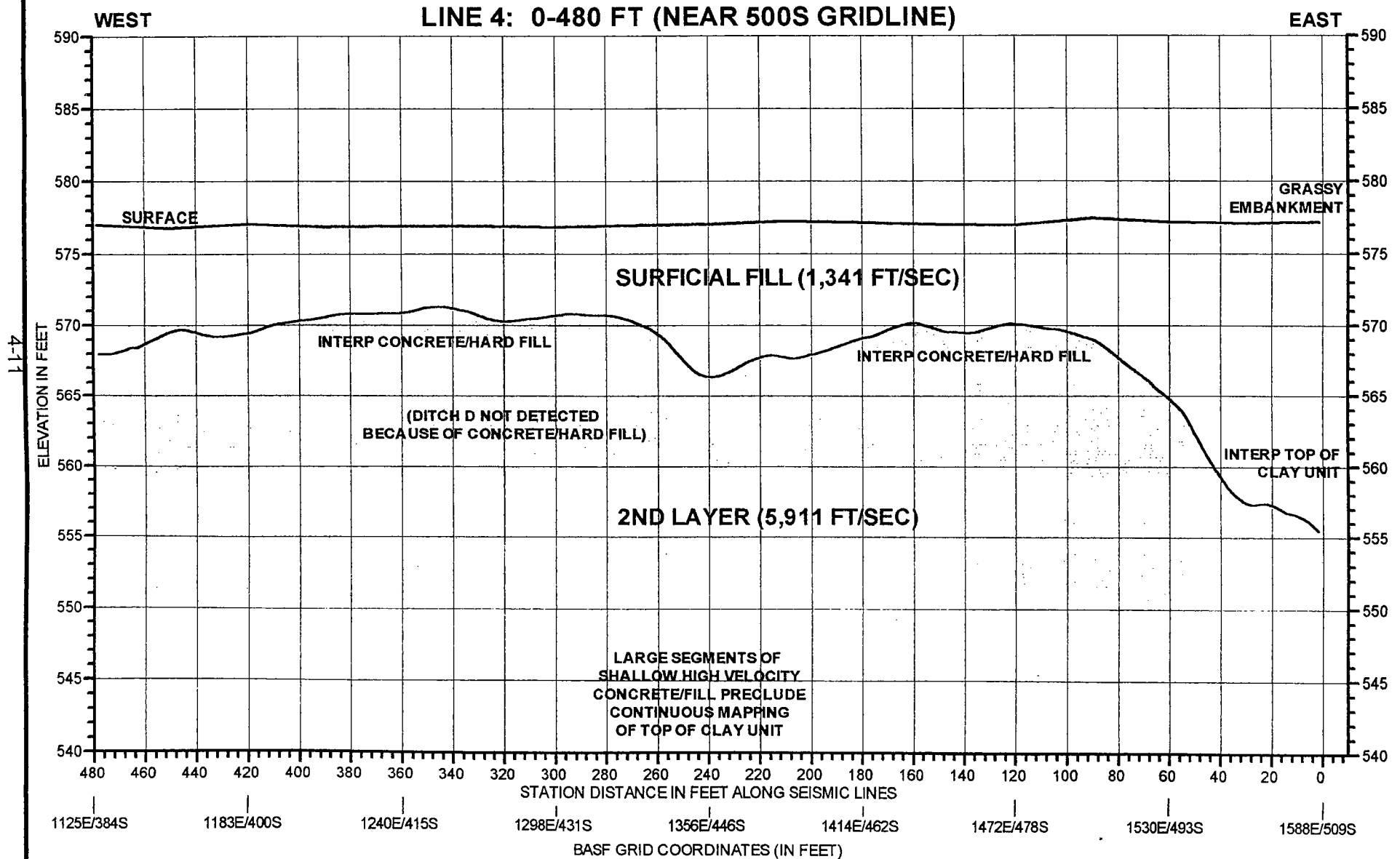
BASF NORTH WORKS: SEISMIC REFRACTION LINE 2 INTERPRETED SEISMIC/GEOLOGIC SECTION



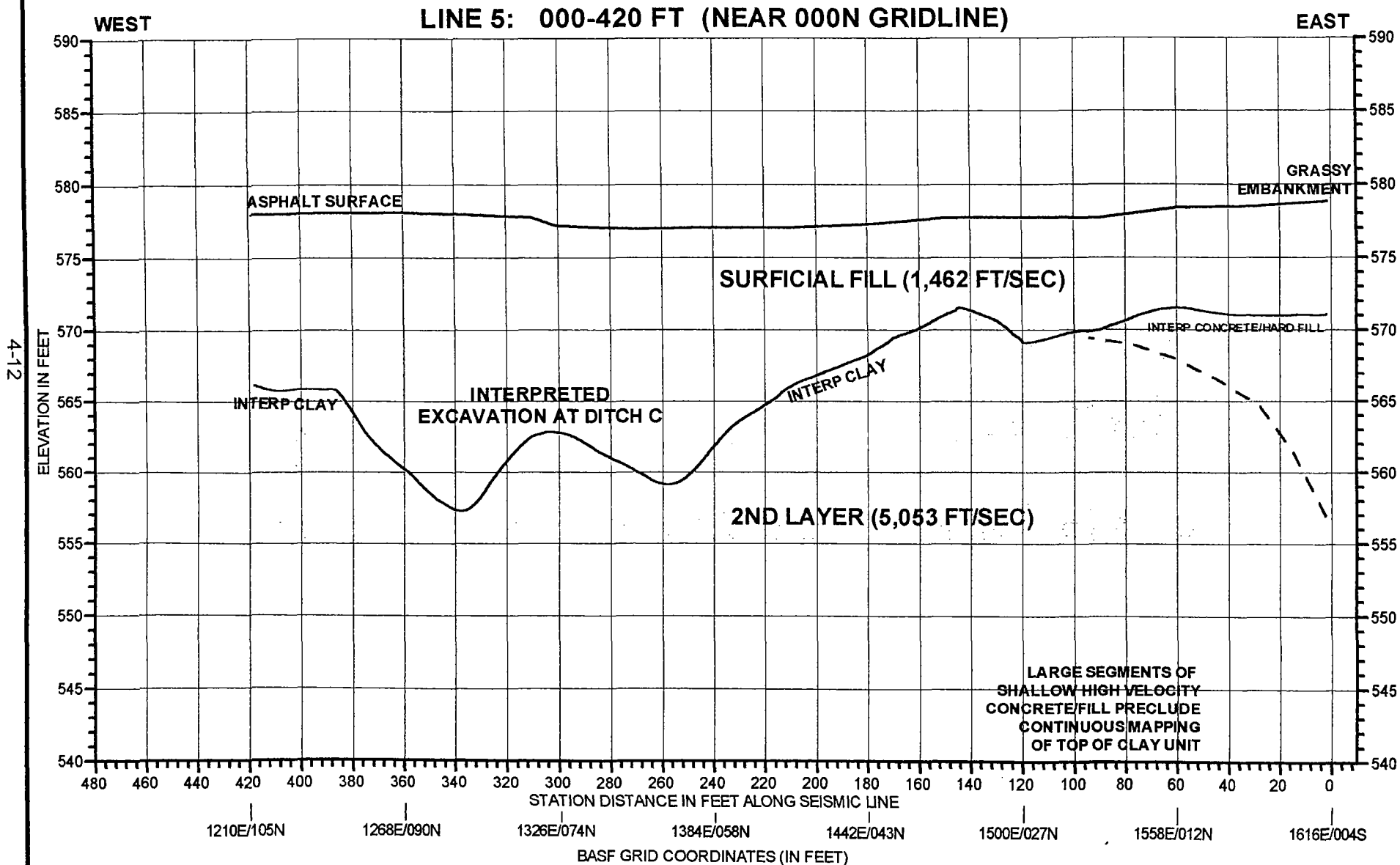
BASF NORTH WORKS: SEISMIC REFRACTION LINE 3 INTERPRETED SEISMIC/GEOLOGIC SECTION



BASF NORTH WORKS: SEISMIC REFRACTION LINE 4 INTERPRETED SEISMIC/GEOLOGIC SECTION



BASF NORTH WORKS: SEISMIC REFRACTION LINE 5 INTERPRETED SEISMIC/GEOLOGIC SECTION



APPENDICES

APPENDIX A

EM AND SEISMIC DESCRIPTIONS	A-1
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APPENDIX B

SEISMIC REFRACTION: TIME-DISTANCE PLOTS	B-1
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APPENDIX A

EM AND SEISMIC DESCRIPTIONS

Electrical Methods

Electrical properties are among the most useful geophysical parameters in characterizing earth materials. Variations in electrical conductivity (or its inverse, resistivity) typically correlate with variations in water saturation, fluid conductivity, porosity, permeability, and the presence of metal. Depending on the particular site, these variations may be used to locate contaminant plumes, salt water intrusion, stratigraphic units, sinkholes, fractures, buried drums and tanks, and any other feature whose electrical properties contrast with the surrounding earth.

Ground conductivity can be measured either directly, using the galvanic resistivity method, or inductively, using electromagnetic induction (EM). Because EM requires no direct contact with the ground surface, data can be acquired more quickly than with resistivity. Resistivity, however, can provide better vertical resolution and is generally less sensitive to cultural noise such as fences, buildings and overhead powerlines.

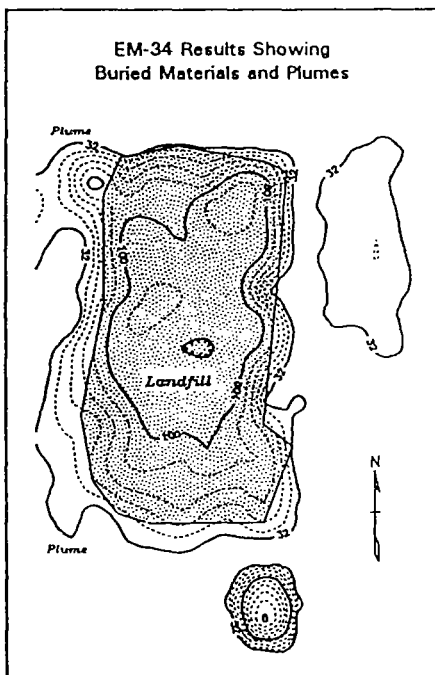
Electromagnetic Induction

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Applications of Electrical Methods

EM and resistivity can be applied to a wide variety of problems encountered in environmental, ground water, geotechnical, and archaeological work, including:

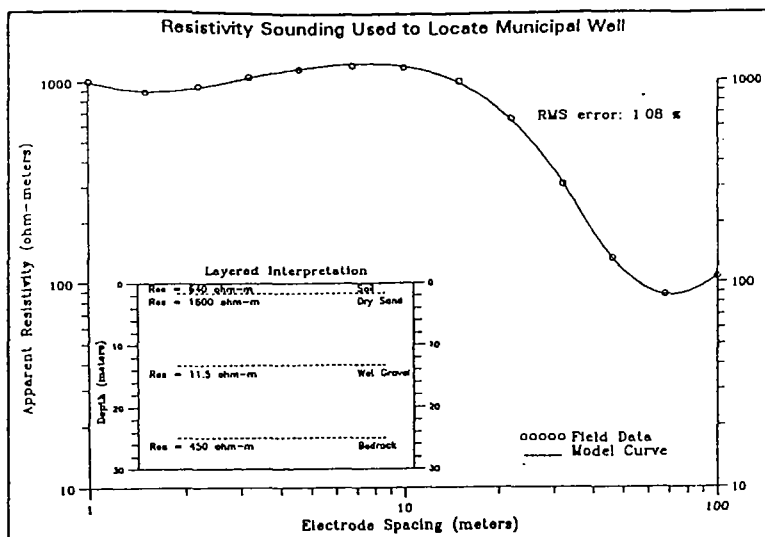
- Location of buried drums, tanks, trenches, and utilities
- Location of landfills and bulk buried materials
- Delineation of contaminant plumes
- Depth of water table and aquifer identification and mapping
- Continuity of stratigraphic interfaces such as clay layers
- Mapping of faults and fractures
- Location of karst features



Galvanic Resistivity

Using an older technique called resistivity, electrical conductivity (resistivity) can also be measured by applying a current directly into the ground through a pair of electrodes. A voltage difference measured across a second electrode pair provides the necessary information to calculate the apparent earth resistivity (the inverse of apparent conductivity). The depth of investigation depends on the electrode separation and geometry, with greater electrode separations yielding bulk resistivity measurements to greater depths.

The EM and resistivity methods are used in two different modes: **profiling** and **sounding**. Profiling is used to detect lateral variations across a site by taking a series of readings along a line using a fixed configuration of coils or electrodes. (EM is typically used in the profile mode). Soundings are used to estimate vertical variations in electrical conductivity or resistivity. A resistivity sounding is made by taking many readings with increasing electrode separations at a single location. An EM sounding is obtained by taking readings at a single location with several coil spacings and coil orientations. The data are then inverted to produce a model of conductivity (resistivity) variations with depth. Due to the greater number of readings possible, resistivity soundings provide better vertical resolution than EM soundings. Profiles and soundings may be obtained simultaneously to yield a 3-dimensional model.



While both EM and resistivity measure apparent ground conductivity, their response to certain kinds of anomalies differs markedly. EM is very sensitive to highly conductive media, so a thin, high conductivity layer may dominate over much thicker, low conductivity layers. Also, if conductivities are very high, the measurements become non-linear and eventually turn negative. The resistivity method is less sensitive to thin, high conductivity layers and can measure even the lowest and highest apparent conductivities.

Field Procedures

For EM work, Geosphere uses the Geonics EM-31DL, EM-34XL, and EM-38 instruments. All instruments read apparent conductivity directly in units of millimhos/meter. The one-man portable

EM-31 has a fixed coil separation with an investigative depth of 20 feet. The EM-34 requires a crew of two and has three coil separations, with investigative depths from 25 to 200 feet. Geosphere has rigged a 4x4 truck to acquire continuous data over large areas using the 10 meter configuration; this method has proved valuable in locating and mapping deep karst features, faults, and buried sand channels. The EM-38 measures shallow soil conductivities to depths of 3 to 6 feet. With all three instruments, data are acquired either on analog strip charts or digitally which are downloaded to a field computer. The in-phase component of these EM systems also provide valuable data concerning the location of buried metal objects and pipes. Other EM systems available include the EM-39 borehole induction logger.

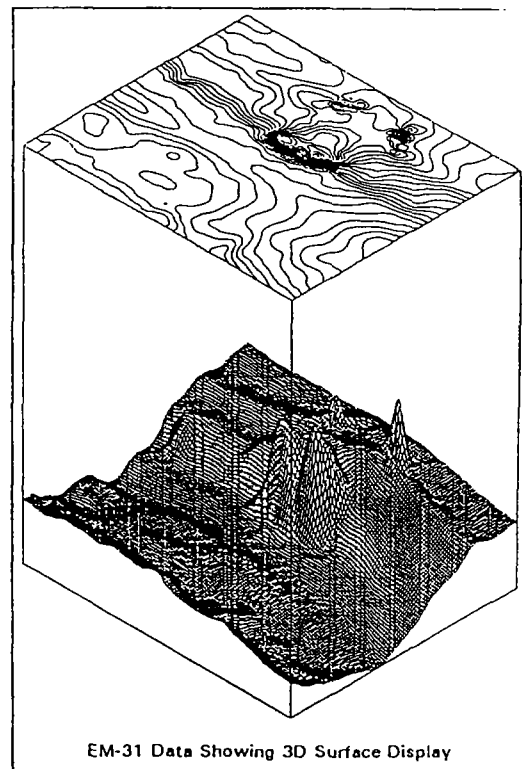
Resistivity surveys usually employ a Wenner electrode array (four co-linear, equally-spaced electrodes) and an ABEM Terrameter earth resistivity meter. The instrument reading in ohms (applied current divided into the measured voltage difference) is converted to apparent resistivity (in ohm-meters) by means of a geometric factor determined for the electrode array. For soundings, the inter-electrode spacings are varied approximately logarithmically (six readings per decade) over a range determined for the particular site.

Data Processing

Conductivity profile data are often computer gridded, producing a data set which can be contoured or displayed as a 3-dimensional surface. Resistivity sounding data are inverted, using in-house computer software, producing a model of discrete layers, each of constant resistivity (or conductivity). The inversion routine computes theoretical curves based on a trial model and adjusts the model parameters iteratively until it achieves a satisfactory match with the field data. Geologic interpretation of electrical conductivity data involves matching observed anomalies with characteristic responses to known features. Constraining information, such as well data, outcrops, or other geophysical data, is very useful in producing a comprehensive, coordinated interpretation.

Summary

Electrical geophysical techniques are extremely useful in a wide variety of situations. For example, the EM method can quickly provide very high density information which cannot otherwise be obtained in critical areas. Geosphere is among the leaders nationwide in applying electrical methods to environmental investigations, hazardous waste sites, ground water exploration, karst features, archaeology, and other disciplines.



Seismic Exploration

"Seeing" with sound is a familiar concept. Bats and submarines do it and so does a blind man with a cane. In total darkness we can sense whether we are in a closed or open space by the echoes from our footsteps.

Seismic exploration, in principle, is nothing more than a mechanized version of the blind person and his cane. In place of the tapping cane we have a hammer blow on the ground, or an explosion in a shallow hole, to generate sound waves. And we "listen" with geophones, spring-mounted electric coils moving within a magnetic field, which generate electric currents in response to ground motion. Careful analysis of the motion can tell us whether it is a direct surface-borne wave, one reflected from some subsurface geologic interface, or a wave refracted along the top of an interface. Each of these waves tells us something about the subsurface.

Seismic Reflection

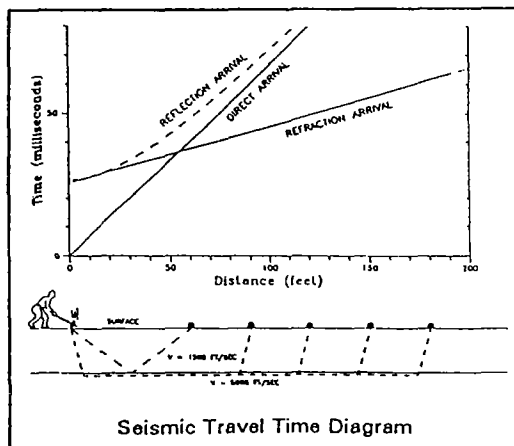
Reflections of sound waves from the subsurface arrive at the geophones some measurable time after the source pulse. If we know the speed of sound in the earth and the geometry of the wave path, we can convert that seismic travel time to depth. By measuring the arrival time at successive surface locations we can produce a profile, or cross-section of seismic travel times. A simple concept.

In practice, the speed of sound in the earth varies enormously. Dry, unconsolidated sand might carry sound waves at 800 feet per second (fps) or less. At the other extreme, unfractured granite might have a velocity in excess of 20,000 fps. And the more layers between the surface and the layer of interest, the more complicated the velocity picture. Various methods are used to estimate subsurface velocities, including refraction analysis, borehole geophysical measurements, estimates from known lithologic properties, and analysis of reflection times at increasing offsets. Generally, a combination of velocity estimation methods will give the best results.

Seismic Refraction

When a sound wave crosses an interface between layers of two different velocities, the wave is refracted. That is, the angle of the wave leaving the interface will be altered from the incident angle, depending on the relative velocities. Going from a low-velocity layer to a high-velocity layer, a wave at a particular incident angle (the "critical angle") will be refracted along the upper surface of the lower layer. As it travels, the refracted wave spawns upgoing waves in the upper layer, which impinge on the surface geophones.

Sound moves faster in the lower layer than the upper, so at some point, the wave refracted along that surface will overtake the direct wave. This refracted wave is then the first arrival at all subsequent geophones, at least until it is in turn overtaken by a deeper, faster refraction. The difference in travel time of this wave arrival between geophones depends on the velocity of the lower layer. If that layer is plane and level, the refraction arrivals form a straight line whose slope corresponds directly to that velocity. The point at which the refraction overtakes the direct arrival is known as the "critical distance", and can be used to estimate the depth to the refracting surface.



Applications of Seismic Methods

Seismic reflection and refraction have numerous potential applications to a variety of environmental and geotechnical problems, including:

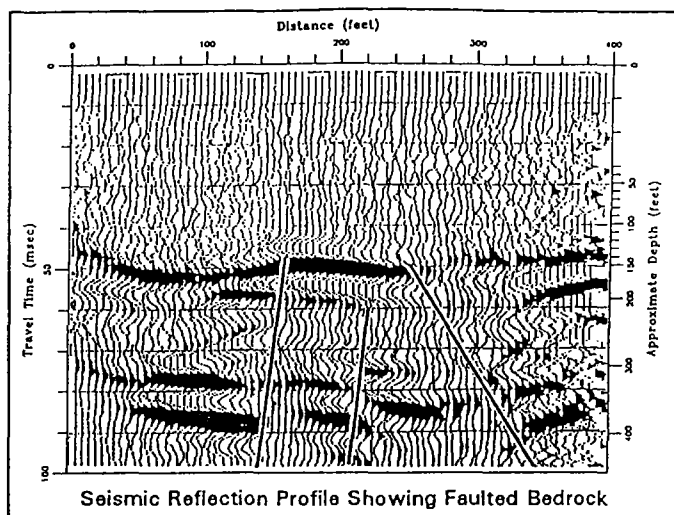
- Depth and characterization of bed-rock surface
- Buried channel definition
- Depth of water table
- Depth and continuity of stratigraphic interfaces
- Rippability determination
- Mapping of faults and other structural features
- Location of karst features

Field Procedures

Seismic field acquisition involves three basic elements:

- a source of acoustic energy
- seismic receivers, or geophones
- a seismograph to record the data

The choice of seismic source depends on the needs of the particular survey. For deeper work, a powerful source, such as the "Elastic Wave



Seismic Reflection Profile Showing Faulted Bedrock

depends on the nature of the survey. For seismic reflection, the relative source and geophone positions are usually held constant, the entire 24-geophone array being moved along with the shot. (The logistical difficulties of this are eased by using a "roll switch", which selects 24 geophones from an overall spread of 48.) Refraction work requires shots at opposite ends of the spread, with additional shot locations depending on the particular needs of the job.

Data Processing

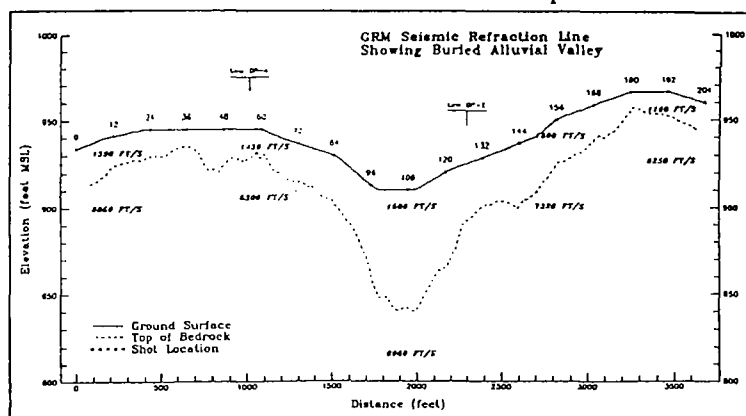
A seismic reflection section is, in principle, a series of seismic traces recorded by a geophone at the same location as the shot. Each trace must be time-corrected to allow for the source-geophone offset, the correction depending on the layer velocities. If the correction is accurate, a given reflection is moved up the trace to the position it would have were the source and receiver coincident. Using the field procedure described above, 12 individual traces, of various source-receiver offsets, will have a common midpoint. These 12 traces, after correction, are summed to produce one common depth point, or 12-fold CDP trace. The resulting summed traces are then displayed as a single seismic cross-section.

A seismic trace may contain as many as 4000 individual samples. With each shot generating 24 traces, a typical seismic line will contain several million samples. Geosphere processes these data with the "Eavesdropper" package, developed by the Kansas Geological Survey for 386/486 PC computers. Specialized reflection data can also be processed using common offset software developed by the Canadian Geologic Survey. Augmented by several programs developed by Geosphere, we now have a seismic reflection processing system tailored to the unique problems encountered in high-resolution seismic work. We believe this system to be unmatched in the industry.

Seismic refraction data can be interpreted in several ways. The simplest approaches assume a series of plane, dipping layers. While effective in many instances, this method is not suited to irregular or undulating layers. The Generalized Reciprocal Method (GRM) goes beyond the plane-layer assumption, producing a profile which allows for irregularities in the refracting surface. When possible, we combine GRM results with reflection data to produce the most comprehensive seismic interpretation available.

Summary

Seismic exploration is a powerful geophysical technique. The same principles which have achieved unparalleled success in the petroleum industry can also enhance environmental and hazardous waste site investigations, ground water exploration, geotechnical engineering, archaeology, and mining exploration. At Geosphere, we intend to continue providing the most effective, state-of-the art seismic exploration available.



Generator", a trailer-mounted accelerated weight drop, would be used. Shallow, high-resolution work demands a high-frequency source, such as the "Betsy" downhole shotgun. Geophones are also selected according to the needs of the survey: higher-frequency phones for high-resolution work, lower-frequency for deeper targets. Our Bison Instruments 8024 and 9024 seismographs both offer 24-channel recording capability, with internal data storage to enhance field productivity. The 9024 floating-point system is arguably the best engineering seismograph available today, with recording specifications better than many oil industry systems.

Typically, the geophones are placed along a line at equal intervals (3 to 5 feet for high-resolution, 10 to 20 feet for deeper work). The arrangement of source and geophones

APPENDIX B**SEISMIC REFRACTION: TIME - DISTANCE PLOTS**

Figure B-1: Seismic Line 1: Time-distance Plot of First Arrival Picks Along Line

Figure B-2: Seismic Line 2: Time-distance Plot of First Arrival Picks Along Line

Figure B-3: Seismic Line 3: Time-distance Plot of First Arrival Picks Along Line

Figure B-4: Seismic Line 4: Time-distance Plot of First Arrival Picks Along Line

Figure B-5: Seismic Line 5: Time-distance Plot of First Arrival Picks Along Line

Notes:

1. Different types of data points (filled and unfilled) in the following plots serve to differentiate the numerous lines from one another.
2. Flatter-lying lines at low time values are indicative of higher velocity fill and interpreted concrete structures (see Figure B-4 for best example) in the second layer.
3. The observed range in velocities for the first layer is normal and is ascribed to significant variations in the character, density and water content of the surficial fill layer.
4. The observed wide range in velocities for the second layer is caused by the widespread occurrence (particularly in Lines 3, 4 and 5) of hard fill/concrete layers and water content in conjunction with the underlying clay layer.

SEISMIC LINE 1: TIME - DISTANCE PLOT OF FIRST ARRIVAL PICKS ALONG LINE

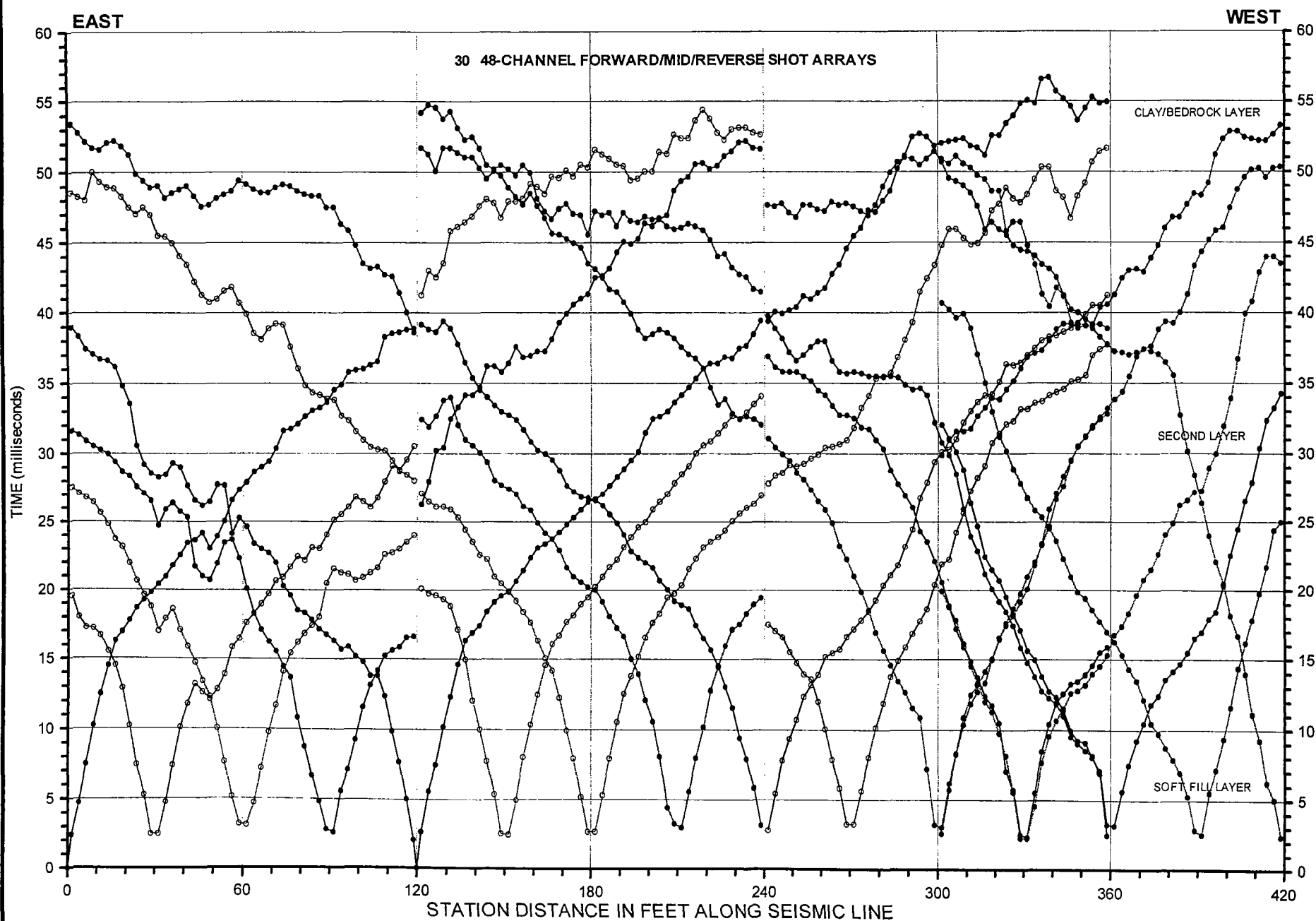


FIGURE B-1

SEISMIC LINE 2: TIME - DISTANCE PLOT OF FIRST ARRIVAL PICKS ALONG LINE

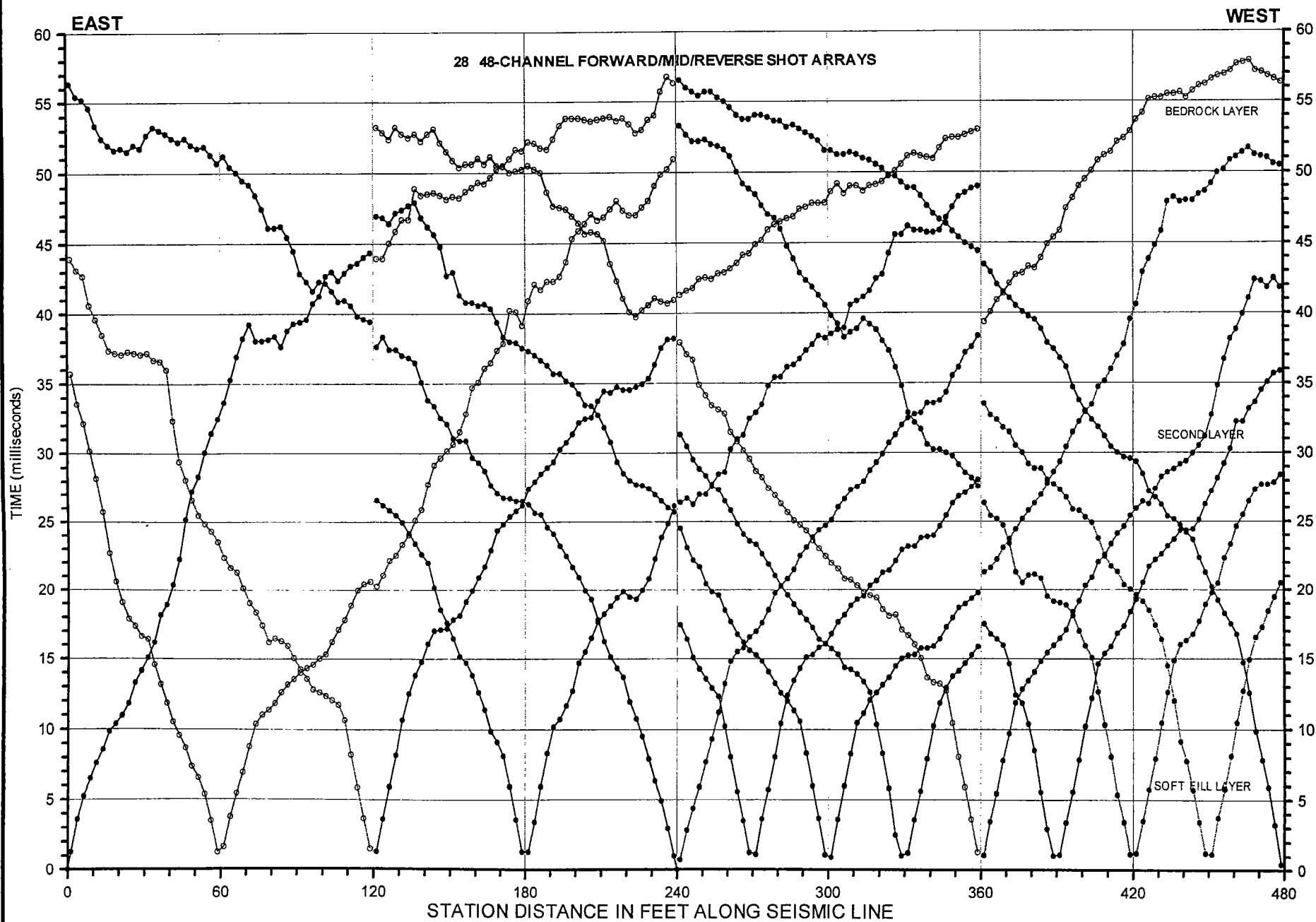


FIGURE B-2

BASF NORTH WORKS, WYANDOTTE, MICHIGAN

GEOSPHERE 6/30/99

SEISMIC LINE 3: TIME - DISTANCE PLOT OF FIRST ARRIVAL PICKS ALONG LINE

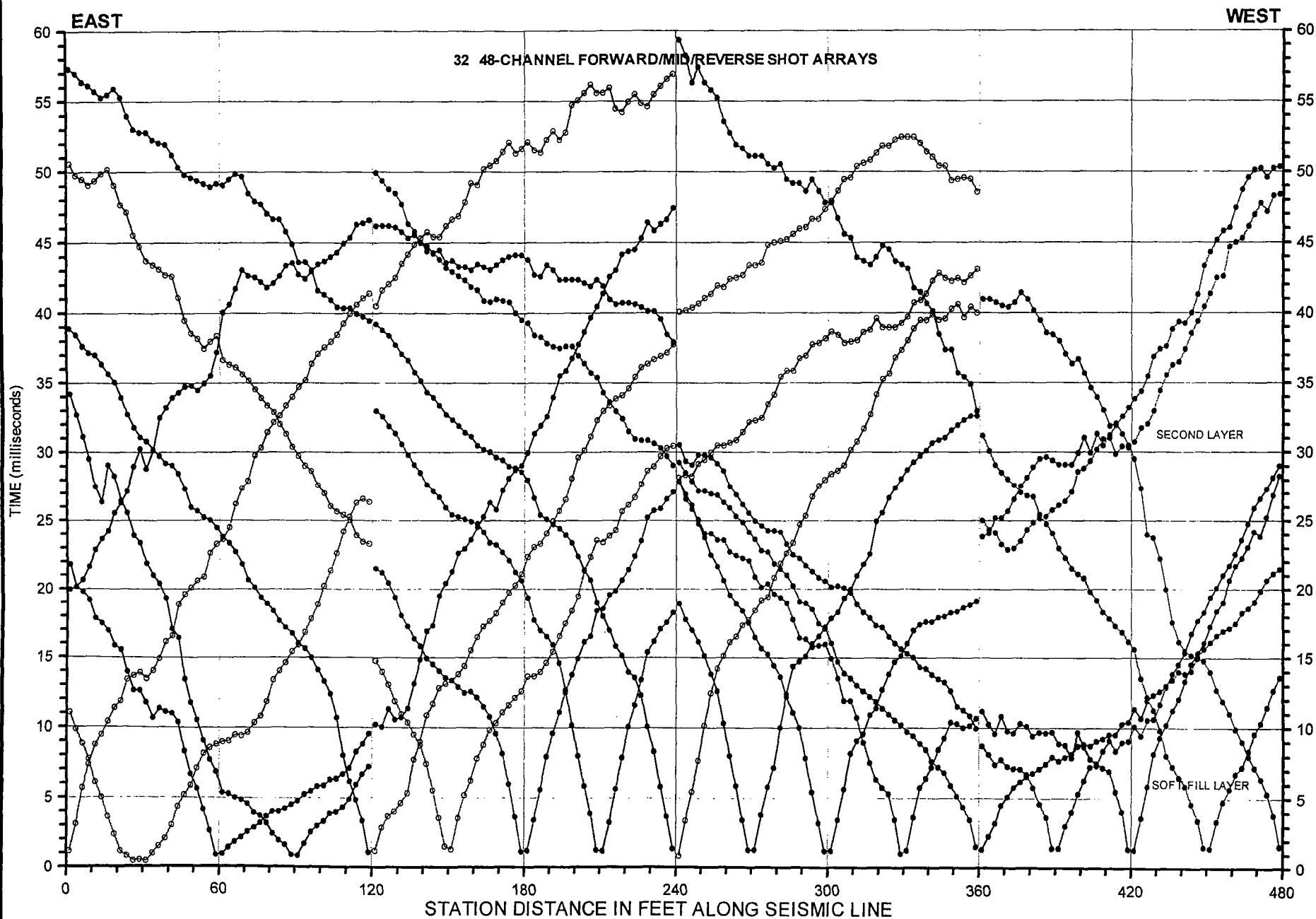


FIGURE B-3

BASF NORTH WORKS, WYANDOTTE, MICHIGAN

GEOSPHERE 6/30/99

SEISMIC LINE 4: TIME - DISTANCE PLOT OF FIRST ARRIVAL PICKS ALONG LINE

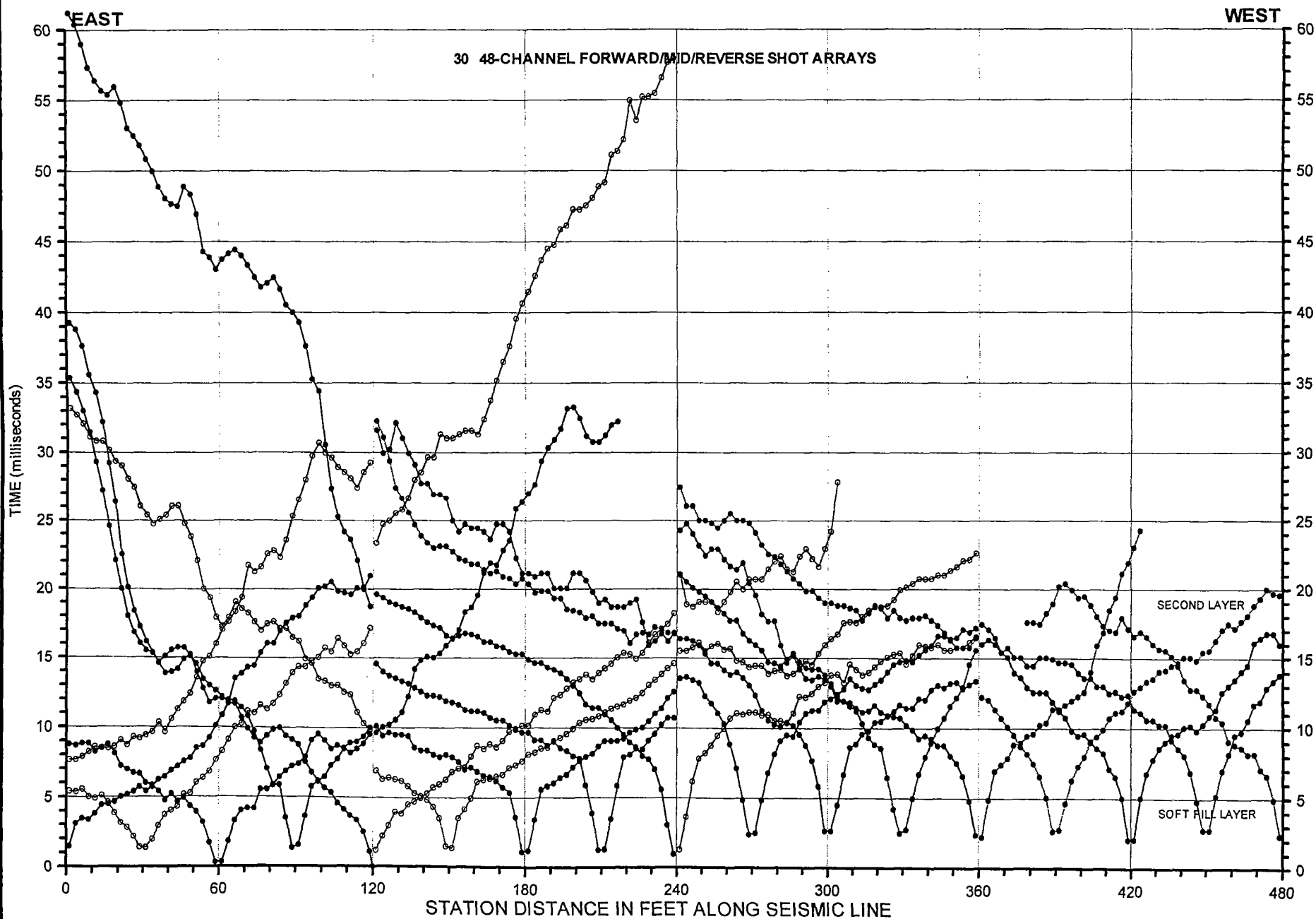


FIGURE B-4

BASF NORTH WORKS, WYANDOTTE, MICHIGAN

GEOSPHERE 6/30/99



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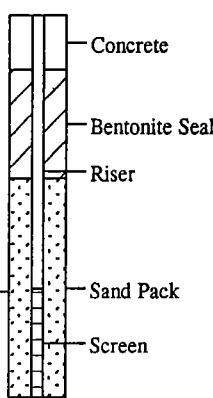
LOG OF BORING CMS-MW1

(Page 1 of 1)

BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/4/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : 580.37 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well Construction Information
0	Grass to 6". Topsoil to 1' bgs. Lt. gray sand fill, trace red brick, loose, dry to 3'.	FILL		0.0	40	<p>Well: CMS-MW1 Elev.: 582.36' TOC</p> <p>Cover</p> 
1				0.0	30	
2		FILL		0.0	30	
3	Dark gray to black med. sand fill, trace gravel, trace fines, med. dense, dry.			0.0	30	
4		FILL		0.0	90	
5	Black gravel with sand fill, trace fines, loose, moist.			0.0	90	
6		FILL		0.0	90	
7				0.0	90	
8		SP		0.0	20	
9	Medium gray sand, some clay, trace gravel, loose, wet.			0.0	20	
10		CL		0.0	25	
11	Olive gray with light brown mottled silty clay, trace sand, moist.			0.0	25	
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

WELL CONSTRUCTION

Date Compl. : 8/4/99
Hole Diameter : 8.25"
Drill. Method : HSA
Parsons ES Rep. : M. Pawlyk

WELL RISER

Material : SS
Diameter : 2 in.
Joints : threaded

WELL SCREEN

Material : SS
Diameter : 2 in.
Joints : threaded
Opening : .010 slot
Length : 2'

SAND PACK : Silica filter sand

ANNULUS SEAL : bentonite chips

NOTES

2 bags of 50 lbs. filter sand.
2 bags of 50 lbs. bentonite chips.
2' X 2' concrete well pad at surface.
Stick-up protective casing - 6" diameter.

* Monitoring well CMS-MW1 was blind-drilled to depth of 7 feet adjacent to initial 12-ft. boring.

Checked by: WLB



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LOG OF BORING CMS-MW2

(Page 1 of 1)

BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/4/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : 577.69 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well Construction Information
0	Med. gray to lt. gray gravel fill, some med. to cse. sand, loose to med. dense, dry.	FILL		0.0	40	<p>Well: CMS-MW2 Elev.: 577.34' TOC</p> <p>WELL CONSTRUCTION</p> <p>Date Compl. : 8/4/99 Hole Diameter : 8.25" Drill. Method : HSA Parsons ES Rep. : M. Pawlyk</p> <p>WELL RISER</p> <p>Material : SS Diameter : 2 in. Joints : threaded</p> <p>WELL SCREEN</p> <p>Material : SS Diameter : 2 in. Joints : threaded Opening : .010 slot Length : 5' SAND PACK : Silica filter sand</p> <p>ANNULUS SEAL : bentonite chips</p>
1						
2	Med. to cse. sand fill, cse. lt. gray calcareous particles, dense, dry to moist.	FILL		0.0	100	
3						
4	Same as 2' - 4', moist at 4', wet at 4.5'.					
5				0.0	80	<p>NOTES</p> <p>5 bags of 50 lbs. filter sand. 1 bag of 50 lbs. bentonite chips. 2' X 2' concrete well pad at surface. Flush-mount protective casing - 10" diameter.</p>
6		FILL				
7				0.0	50	
8						
9						
10						
11						
12						
13						
14						
15						
16						
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19						
20						
21						
22						

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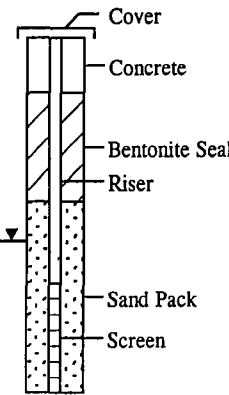
LOG OF BORING CMS-MW3

(Page 1 of 1)

BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/4/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : 578.31 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well Construction Information
0	Lt. gray gravel fill, some sand, med. dense, dry.	FILL		0.0	80	<p>Well: CMS-MW3 Elev.: 578.08' TOC</p> 
1						
2	Lt. gray to med. gray gravel fill, little sand, moist.	FILL		0.0	90	
3						
4						<p>WELL CONSTRUCTION Date Compl. : 8/4/99 Hole Diameter : 8.25" Drill. Method : HSA Parsons ES Rep. : M. Pawlyk WELL RISER Material : SS Diameter : 2 in. Joints : threaded WELL SCREEN Material : SS Diameter : 2 in. Joints : threaded Opening : .010 slot Length : 2' SAND PACK : Silica filter sand ANNULUS SEAL : bentonite chips</p>
5	Med. gray sand with gravel, med. loose, wet.	FILL		11.3	50	
6						
7						
8						<p>NOTES 2 bags of 50 lbs. filter sand. 1 bag of 50 lbs. bentonite chips. 2' X 2' concrete well pad at surface. Flush-mount protective casing - 10'' diameter.</p>
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

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LOG OF BORING CMS-MW4

(Page 1 of 1)

BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/5/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : 580.04 Feet
Suncontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well: CMS-MW4 Elev.: 581.78' TOC Cover	Well Construction Information
0	Grass with topsoil to 6".						WELL CONSTRUCTION Date Compl. : 8/4/99 Hole Diameter : 8.25" Drill. Method : HSA Parsons ES Rep. : M. Pawlyk WELL RISER Material : SS Diameter : 2 in. Joints : threaded WELL SCREEN Material : SS Diameter : 2 in. Joints : threaded Opening : .010 slot Length : 7' SAND PACK : Silica filter sand ANNULUS SEAL : bentonite chips NOTES 5.5 bags of 50 lbs. filter sand. 2 bags of 50 lbs. bentonite chips. 2' X 2' concrete well pad at surface. Stick-up protective casing - 6" diameter.
1	6"-1': Lt. gray limestone gravel fill.	FILL		0.0	50		
2	1'-2': Lt. brn to lt. gray sand fill, fine to cse., some silt, trace clay, dense, dry.						
3	Lt. gray LIMESTONE gravel fill, very dense, dry.	FILL		0.0	40		
4	No recovery due to apparent coarse materials.						
5							
6							
7				NA	0		
8							
9							
10	Dk. gray to black gravel with sand fill, med. dense, wet, slight odor.	FILL		19.0	25		
11							<p>Concrete Bentonite Seal Riser Sand Pack Screen</p>
12	No recovery.			NA	0		
13							
14	Dk. gray gravel with sand fill to 15', dense, wet.	FILL		0.0	40		
15	Lt. gray to med. gray peat, some fine sand, some clay, trace organics, soft, wet.	PT					
16							
17							
18							
19							
20							
21							
22							

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LOG OF BORING CMS-MW5

(Page 1 of 1)

BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/5/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : 580.93 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well: CMS-MW5 Elev.: 583.27' TOC Cover	Well Construction Information
0	Grass with topsoil, dry, to 6". Dk. gray to black coal slag, some gravel, loose, dry.	FILL		0.0			WELL CONSTRUCTION Date Compl. : 8/4/99 Hole Diameter : 8.25" Drill. Method : HSA Parsons ES Rep. : M. Pawlyk WELL RISER Material : SS Diameter : 2 in. Joints : threaded WELL SCREEN Material : SS Diameter : 2 in. Joints : threaded Opening : .010 slot Length : 7' SAND PACK : Silica filter sand ANNULUS SEAL : bentonite chips
1							
2	Black coal slag, fine, some cse. chunks, loose, moist at 3'.	FILL		0.0			
3	Reddish-orange slag, medium, moist to wet at bottom.	FILL		0.0			
4							
5		FILL		0.0			
6	White to lt. gray putty-like material, fill, with dark gray med.-sized particles, moist to wet, soft, to 9'.	FILL		0.0			
7							
8							
9	White fine-grained putty-like fill, very soft, wet.			0.0			
10							NOTES 5 bags of 50 lbs. filter sand. 3 bags of 50 lbs. bentonite chips. 2' X 2' concrete well pad at surface. Stick-up protective casing - 6" diameter.
11				0.0			
12		FILL		0.0			
13							
14				0.0			
15	Dk. gray clayey peat with brown organics, soft, wet.	PT		0.0			
16	Lt. gray silty clay, trace organics, med. stiff, wet.	CL					
17							
18							
19							
20							
21							
22							

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LOG OF BORING CMS-MW6

(Page 1 of 1)

BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/9/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : 585.51 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well: CMS-MW6 Elev.: 587.55' TOC Cover	Well Construction Information
0	Grass with topsoil, dry, to 6".	FILL				<p>Concrete</p> <p>Bentonite Seal</p> <p>Riser</p> <p>Sand Pack</p> <p>Screen</p>	WELL CONSTRUCTION Date Compl. : 8/9/99 Hole Diameter : 8.25" Drill. Method : HSA Parsons ES Rep. : M. Pawlyk WELL RISER Material : SS Diameter : 2 in. Joints : threaded WELL SCREEN Material : SS Diameter : 2 in. Joints : threaded Opening : .010 slot Length : 5' SAND PACK : Silica filter sand ANNULUS SEAL : bentonite chips
1	Dk. gray to black granular to fine coal, med. dense, dry.			0.0	70		
2							
3		FILL		0.0	80		
4							
5	Tan, very soft, fine grained fill material, putty-like consistency, with sand, moist.			0.0	80		
6		FILL					
7				0.0	90		
8	White putty-like fill, fine-grained, trace sand, soft, wet.			0.0	90		
9							
10						<p>Bentonite Seal</p> <p>Riser</p> <p>Sand Pack</p> <p>Screen</p>	NOTES 6 bags of 50 lbs. filter sand. 5 bags of 50 lbs. bentonite chips. 2' X 2' concrete well pad at surface. Stick-up protective casing - 6" diameter.
11		FILL		0.0	100		
12							
13				0.0	90		
14							
15	Dark gray gravel, some sand, trace coal dust, very loose.	FILL		0.0	70		
16	White fine-grained putty-like material, soft, wet.						
17		FILL		0.0	80		
18							
19	Dark gray sandy clay with peat, with organics, med. stiff to soft, moist to wet.	PT		0.0	60		
20	Lt. gray to med. gray silty clay, little organics, med. stiff, moist.	CL					
21							
22							

Checked by: WLB



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SCIENCE, INC.**

LOG OF BORING CMS-MW7

(Page 1 of 1)

BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/10/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : 577.76 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well Construction Information
0	Grass with topsoil, dry, to 1'. Med. gray gravel with sand, med. dense, dry.	FILL		0.0	60	<p>Well: CMS-MW7 Elev.: 579.93' TOC</p> <p>Cover</p> <p>Concrete</p> <p>Bentonite Seal</p> <p>Riser</p> <p>Sand Pack</p> <p>Screen</p> <p>WELL CONSTRUCTION</p> <p>Date Compl. : 8/4/99 Hole Diameter : 8.25" Drill. Method : HSA Parsons ES Rep. : M. Pawlyk</p> <p>WELL RISER</p> <p>Material : SS Diameter : 2 in. Joints : threaded</p> <p>WELL SCREEN</p> <p>Material : SS Diameter : 2 in. Joints : threaded Opening : .010 slot Length : 2'</p> <p>SAND PACK : Silica filter sand</p> <p>ANNULUS SEAL : bentonite chips</p> <p>NOTES</p> <p>3 bags of 50 lbs. filter sand. 2 bags of 50 lbs. bentonite chips. 2' X 2' concrete well pad at surface. Stick-up protective casing - 6" diameter.</p>
1						
2	Not sampled due to concrete rubble fill.					
3				0.0	0	
4						
5				0.0	0	
6		FILL				
7				0.0	0	
8						
9				0.0	0	
10						
11	Med. gray gravel with clay, some organics, soft, wet.	FILL				
12	Med. gray sandy peat, some roots, soft, wet.	PT		0.0	70	
13	Lt. gray to med. gray silty clay, trace roots, soft, wet.	CL		0.0	80	
14						
15						
16						
17						
18						
19						
20						
21						
22						

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ENGINEERING
SCIENCE, INC.**


LOG OF BORING CMS-MW8

(Page 1 of 1)

BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/10/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : 576.69 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well: CMS-MW8 Elev.: 579.26' TOC Cover	Well Construction Information
0	Grass with topsoil and gravel, loose, dry, to 1'. Concrete with gravel to 2'.	FILL		0.0	80		WELL CONSTRUCTION Date Compl. : 8/10/99 Hole Diameter : 8.25" Drill. Method : HSA Parsons ES Rep. : M. Pawlyk WELL RISER Material : SS Diameter : 2 in. Joints : threaded WELL SCREEN Material : SS Diameter : 2 in. Joints : threaded Opening : .010 slot Length : 4' SAND PACK : Silica filter sand ANNULUS SEAL : bentonite chips
1							
2	No sampling due to concrete rubble fill.			0.0	0		
3							
4							
5		FILL		0.0	0		
6							
7				0.0	0		
8	White, fine-grained putty-like material, trace sand, wet, soft, to 9.8'.	FILL		0.0	80		
9							
10	Greenish to lt. gray to med. gray sandy peat, soft, wet.	PT		0.0	90		NOTES 3.5 bags of 50 lbs. filter sand. 2 bags of 50 lbs. bentonite chips. 2' X 2' concrete well pad at surface. Stick-up protective casing - 6" diameter.
11							
12	Gray silty clay, med. stiff, moist to wet.	CL					
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

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SCIENCE, INC.**

LOG OF BORING CMS-MW9

(Page 1 of 1)

BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/17/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : 577.67 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well: CMS-MW9 Elev.: 580.21' TOC Cover	Well Construction Information
0	Grass with tan sandy topsoil to 1'.	FILL				<p>Concrete</p> <p>Bentonite Seal</p> <p>Riser</p> <p>Sand Pack</p> <p>Screen</p>	<p>WELL CONSTRUCTION</p> <p>Date Compl. : 8/17/99 Hole Diameter : 8.25" Drill. Method : HSA Parsons ES Rep. : M. Pawlyk</p> <p>WELL RISER</p> <p>Material : SS Diameter : 2 in. Joints : threaded</p> <p>WELL SCREEN</p> <p>Material : SS Diameter : 2 in. Joints : threaded Opening : .010 slot Length : 10' SAND PACK : Silica filter sand</p> <p>ANNULUS SEAL : bentonite chips</p> <p>NOTES</p> <p>6.5 bags of 50 lbs. filter sand. 2 bags of 50 lbs. bentonite chips. 2' X 2' concrete well pad at surface. Stick-up protective casing - 6" diameter.</p>
1	Blk. to med. brn. coal slag with sand fill, loose, dry to wet.			2.6	70		
2							
3		FILL		0.0	30		
4							
5				0.0	30		
6	Med. gray clayey sand to sandy clay, trace organics, moist to wet.	FILL					
7	Med. gray cse. sand, trace fine to cse. coal, loose, wet.	FILL		0.0	30		
8	Gray clayey sand with coal slag fill, loose, wet.	FILL					
9				0.0	70		
10	Lt. gray cse. sand fill with fine gravel, trace red brick fill, trace coal, loose, wet. Trace clay at 18'-20'.						
11				0.0	30		
12							
13				0.0	70		
14							
15		FILL		0.0	70		
16							
17				0.0	70		
18							
19				0.0	80		
20	Med. brn. peat, some sand, wet, soft.	PT					
21	Gray silty clay, med. stiff, moist.	CL		0.0	80		
22							

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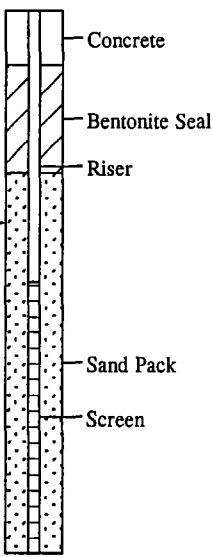
LOG OF BORING CMS-MW10

(Page 1 of 1)

BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/11/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : 576.55 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well: CMS-MW10 Elev.: 579.17' TOC Cover	Well Construction Information
0	Grass with topsoil to 6". Med. gray gravel with sand and coal dust, dense, dry to moist.	FILL		0.0	40		WELL CONSTRUCTION Date Compl. : 8/11/99 Hole Diameter : 8.25" Drill. Method : HSA Parsons ES Rep. : M. Pawlyk WELL RISER Material : SS Diameter : 2 in. Joints : threaded WELL SCREEN Material : SS Diameter : 2 in. Joints : threaded Opening : .010 slot Length : 5' SAND PACK : Silica filter sand ANNULUS SEAL : bentonite chips
1	Gravel, medium gray with sand and coal fragments.	FILL		0.0	70		
2	Tan med. to cse. sand with gravel fill, med. dense, moist.	FILL		0.0	60		
3	Lt. gray to white putty-like fill in granular form, very soft, moist to wet.	FILL		0.0	70		
4	Dk. gray gravel with sand fill, dense, wet, slight ammonia odor.	FILL		43.8	80		
5	Bluish-gray putty-like fill material with granular particles, very soft, wet.	FILL		0.0	100		
6	Med. gray sandy peat, some clay, trace organics, very soft, wet.	PT					
7							
8							
9							
10							NOTES 3.5 bags of 50 lbs. filter sand. 2 bags of 50 lbs. bentonite chips. 2' X 2' concrete well pad at surface. Stick-up protective casing - 6" diameter.
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

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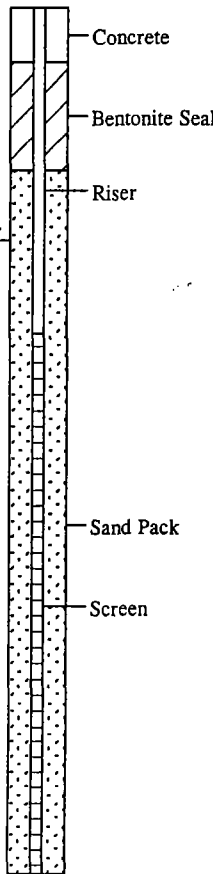
LOG OF BORING CMS-MW11

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BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/11/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : 576.64 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well: CMS-MW11 Elev.: 579.02' TOC Cover	Well Construction Information
0	Grass with topsoil to 6". Med. gray to dark gray coal slag, fine to cse. trace sand, trace gravel, loose, dry to 1.8'. Tan sandy clay fill, trace gravel moist, med. stiff at 1.8' - 2'.	FILL		0.0	60		<p>WELL CONSTRUCTION</p> <p>Date Compl. : 8/11/99 Hole Diameter : 8.25" Drill. Method : HSA Parsons ES Rep. : M. Pawlyk</p> <p>WELL RISER</p> <p>Material : SS Diameter : 2 in. Joints : threaded</p> <p>WELL SCREEN</p> <p>Material : SS Diameter : 2 in. Joints : threaded Opening : .010 slot Length : 10' SAND PACK : Silica filter sand</p> <p>ANNULUS SEAL : bentonite chips</p> <p>NOTES</p> <p>8 bags of 50 lbs. filter sand. 1 bag of 50 lbs. bentonite chips. 2' X 2' concrete well pad at surface. Stick-up protective casing - 6" diameter.</p>
1							
2	Lt. gray and white granular putty-like fill, soft, moist.			0.0	80		
3							
4		FILL		0.0	90		
5							
6							
7				0.0	90		
8	Dk. gray coal slag w/ gravel fill, trace sand, loose, wet.	FILL					
9	Lt. gray and white granular putty-like fill, soft, wet. Some gravel and coal slag from 10'-12'.			0.0	90		
10		FILL					
11				0.0	90		
12	Lt. gray fine sand, some cse. at 13'-14', trace cse. coal slag to 15.8'.			0.0	80		
13		FILL					
14							
15				0.0	70		
16	Lt. gray silty peat, trace sand, trace roots, soft, wet.	PT		0.0	80		
17							
18							
19							
20							
21							
22							

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LOG OF BORING CMS-MW12

(Page 1 of 1)

BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/12/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : K. Carlisle

Ground Elevation : 576.37 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well Construction Information
0	Grass with topsoil to 6". Brn. to blk. granular coal slag and charcoal.	FILL		0.0	50	<p>Well: CMS-MW12 Elev.: 578.79' TOC</p> <p>Cover</p> <p>Concrete</p> <p>Bentonite Seal</p> <p>Riser</p> <p>Sand Pack</p> <p>Screen</p> <p>ANNULUS SEAL : bentonite chips</p>
1		FILL		0.0	5	
2	White to lt. gray fine-grained putty-like fill material, with gravel, wet.	FILL		0.0	40	
3		FILL		0.0	70	
4	Blk. granular charcoal and clay, ammonia odor.	FILL		0.0	50	
5		FILL		0.0	100	
6	Same as above with sulfur odor.					
7						
8						
9	Blk. peat with roots.	PT				
10	Gray to yellowish-gray soft to very soft clay, sulfur odor.	CL				
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

WELL CONSTRUCTION

Date Compl. : 8/11/99
Hole Diameter : 8.25"
Drill. Method : HSA
Parsons ES Rep. : M. Pawlyk

WELL RISER

Material : SS
Diameter : 2 in.
Joints : threaded

WELL SCREEN

Material : SS
Diameter : 2 in.
Joints : threaded
Opening : .010 slot
Length : 5'
SAND PACK : Silica filter sand

ANNULUS SEAL : bentonite chips

NOTES

2 bags of 50 lbs. filter sand.
1.5 bags of 50 lbs. bentonite chips.
2' X 2' concrete well pad at surface.
Stick-up protective casing - 6"
diameter.
5' pre-packed SS screen.

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LOG OF BORING CMS-MW13F

(Page 1 of 1)

BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/16/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

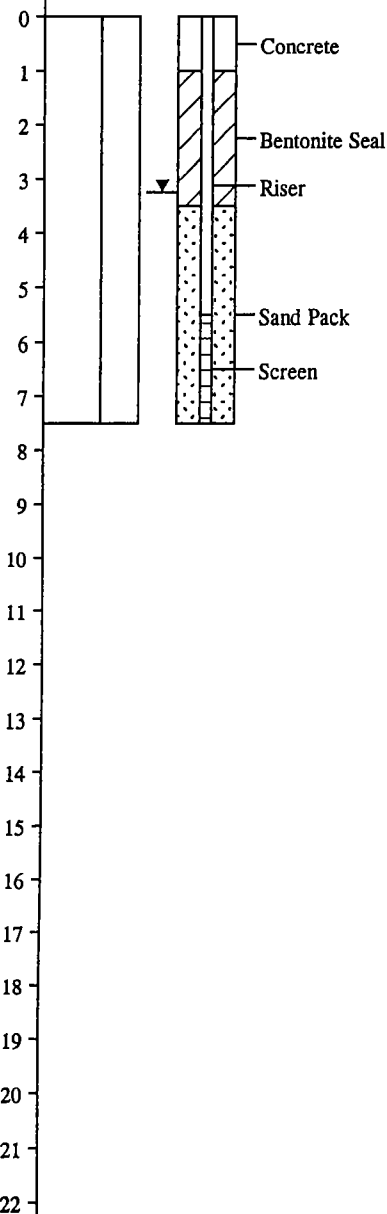
Ground Elevation : 577.32 Feet
Subcontractor : Toltest

Depth
in
Feet

Well: CMS-MW13F
Elev.: 579.50' TOC

Cover

Well Construction Information



WELL CONSTRUCTION

Date Compl. : 8/16/99
Hole Diameter : 8.25"
Drill. Method : HSA
Parsons ES Rep. : M. Pawlyk

WELL RISER

Material : SS
Diameter : 2 in.
Joints : threaded

WELL SCREEN

Material : SS
Diameter : 2 in.
Joints : threaded
Opening : .010 slot
Length : 2'
SAND PACK : Silica filter sand

ANNULUS SEAL : bentonite chips

NOTES

3 bags of 50 lbs. filter sand.
3 bags of 50 lbs. bentonite chips.
2' X 2' concrete well pad at surface.
Stick-up protective casing - 6" diameter.

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LOG OF BORING CMS-MW13S

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BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/16/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : 577.41 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well: CMS-MW13S Elev.: 579.80' TOC Cover	Well Construction Information
0	Grass with topsoil, med. brn. to 1'.	FILL					WELL CONSTRUCTION Date Compl. : 8/16/99 Hole Diameter : 8.25" Drill. Method : HSA Parsons ES Rep. : M. Pawlyk WELL RISER Material : SS Diameter : 2 in. Joints : threaded WELL SCREEN Material : SS Diameter : 2 in. Joints : threaded Opening : .010 slot Length : 7' SAND PACK : Silica filter sand ANNULUS SEAL : bentonite chips NOTES 7 bags of 50 lbs. filter sand. 3 bags of 50 lbs. bentonite chips. 2' X 2' concrete well pad at surface. Stick-up protective casing - 6" diameter.
1	Med. brn. clayey sand, little organics, trace gravel, soft, moist.			4.1	70		
2							
3		FILL		3.0	50		
4							
5	Lt. gray to tan cse. sand fill, loose, wet.	FILL		2.0	60		
6	Med. gray gravel with sand, loose, wet.						
7		FILL		0.0	50		
8	Lt. gray to olive-gray fine to med. sand, loose, wet, sulfur odor.						
9				32.4	100		
10							
11				18.6	100		
12							
13		SP		0.6	100		
14							
15				0.2	100		
16							
17				0.0	100		
18							
19	Lt. gray silty clay, stiff, moist.	CL		0.0	90		
20							
21							
22							

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SCIENCE, INC.**

LOG OF BORING CMS-MW14S

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BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/17/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : 576.93 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well: CMS-MW14S Elev.: 579.39' TOC Cover	Well Construction Information
0	Grass with tan sandy topsoil to 1'.	FILL					WELL CONSTRUCTION Date Compl. : 8/17/99 Hole Diameter : 8.25" Drill. Method : HSA Parsons ES Rep. : M. Pawlyk WELL RISER Material : SS Diameter : 2 in. Joints : threaded WELL SCREEN Material : SS Diameter : 2 in. Joints : threaded Opening : .010 slot Length : 7' SAND PACK : Silica filter sand ANNULUS SEAL : bentonite chips NOTES 5 bags of 50 lbs. filter sand. 2 bags of 50 lbs. bentonite chips. 2' X 2' concrete well pad at surface. Stick-up protective casing - 6" diameter.
1	Black coal slag fill, fine to coarse, loose, dry.	FILL		6.6	90		
2		FILL					
3	Tan fine to med. sand, med. dense, moist to wet.			0.0	50		
4							
5		SP		0.0	50		
6							
7				0.0	100		
8	8' - 9.2' : Olive-tan fine to med. sand, med. dense, wet.						
9	9.2' - 13.5' : Med. gray fine to med. sand, med. dense, wet.			0.0	60		
10		SP					
11				0.0	70		
12							
13				0.0	90		
14	Gray silty clay, stiff, moist.	CL					
15							
16							
17							
18							
19							
20							
21							
22							

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SCIENCE, INC.**

LOG OF BORING CMS-MW15

(Page 1 of 1)

BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/5/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : 577.21 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well Construction Information
0	Lt. gray gravel fill to 2', some sand, med. dense, dry.	FILL		0.0	40	<p>Well: CMS-MW15 Elev.: 577.01' TOC</p> <p>WELL CONSTRUCTION Date Compl. : 8/4/99 Hole Diameter : 8.25" Drill. Method : HSA Parsons ES Rep. : M. Pawlyk WELL RISER Material : SS Diameter : 2 in. Joints : threaded WELL SCREEN Material : SS Diameter : 2 in. Joints : threaded Opening : .010 slot Length : 5' SAND PACK : Silica filter sand ANNULUS SEAL : bentonite chips</p>
1						
2	Lt. gray to med. gray gravel fill, some sand, dense, moist to wet.	FILL		0.0	50	
3						
4	Lt. gray silt to fine sand, very dense, moist.	FILL		0.0	80	
5	Med to cse calcareous fill, wet.					
6		FILL		0.0	90	
7						
8	Lt. gray to med. gray, med. to cse. sand, less calcareous materials, med. dense, wet.	FILL		0.0	90	
9	Med gray peat, some silt, some clay, trace roots.	PT				
10						<p>NOTES 5 bags of 50 lbs. filter sand. 2 bags of 50 lbs. bentonite chips. 2' X 2' concrete well pad at surface. Flush-mount protective casing - 10" diameter.</p>
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

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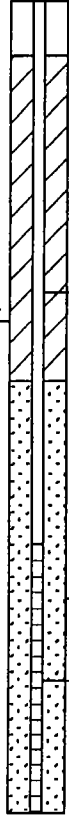
LOG OF BORING CMS-MW16

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BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/18/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : 581.35 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well: CMS-MW16 Elev.: 584.15' TOC Cover	Well Construction Information
0	Grass with sandy tan topsoil, trace gravel, loose, dry.	FILL		0.0	20		<p>WELL CONSTRUCTION</p> <p>Date Compl. : 8/18/99 Hole Diameter : 8.25" Drill. Method : HSA Parsons ES Rep. : M. Pawlyk</p> <p>WELL RISER</p> <p>Material : SS Diameter : 2 in. Joints : threaded</p> <p>WELL SCREEN</p> <p>Material : SS Diameter : 2 in. Joints : threaded Opening : .010 slot Length : 5'</p> <p>SAND PACK : Silica filter sand</p> <p>ANNULUS SEAL : bentonite chips</p> <p>NOTES</p> <p>5 bags of 50 lbs. filter sand. 3 bags of 50 lbs. bentonite chips. 2' X 2' concrete well pad at surface. Stick-up protective casing - 6" diameter.</p>
1							
2	2' - 2.5' : Tan sand fill with gravel, trace coal slag, dense, dry.	FILL		0.0	50		
3	2.5' - 4' : Lt. gray to tan med. to cse. sand fill, with gravel, very dense, dry.	FILL					
4	No sample. Concrete and asphalt fill, very dense.	FILL		NA	NA		
5							
6							
7	Coal dust, some cse. pieces, dense, dry.	FILL					
8				22.4	50		
9	Med. gravel with sand, some coal fragments, moist, dense.	FILL					
10	No recovery.	FILL		NA	NA		
11							
12	Black fine to med. sand, hydrocarbon odor, loose, wet, visible sheen.			121	90		
13		FILL					
14				76	100		
15	Brn. clayey silt, trace organics, med. stiff, moist to wet.	ML-CL					
16	Lt. brn. silty clay, trace organics, med. stiff, moist.	CL-M		15.5	70		
17							
18							
19							
20							
21							
22							

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ENGINEERING
SCIENCE, INC.**

LOG OF BORING CMS-SB17

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BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/17/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

Ground Elevation : NA
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well Construction Information
0	Grass with topsoil to 6";	FILL				NOTES No well installed.
1	Gravel and sand fill, some fines, very dense, dry.	FILL		0.0	70	
2						
3	White fine-grained, putty-like fill, very soft, wet.			0.0	60	
4						
5				0.0	40	
6						
7		FILL		0.0	40	
8						
9				0.0	30	
10						
11				0.0	70	
12	Lt. gray to white granular, putty-like fill, very soft, wet.					
13		FILL		0.0	30	
14						
15				0.0	70	
16	Med. to dk gray peat, some sand, trace organics, soft, wet.	PT				
17	Gray silty clay, stiff, moist.	CL		0.0	70	
18						
19						
20						
21						
22						

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ENGINEERING
SCIENCE, INC.**

LOG OF BORING CMS-MW18

(Page 1 of 1)

BASF Corporation
Corrective Measures Study
Wyandotte, Michigan
North Works Facility

Date Completed : 8/18/99
Hole Diameter : 8.25"
Drilling Method : Hollow Stem Auger
Sampling Method : Split-Spoon
Parsons ES Rep. : M. Pawlyk

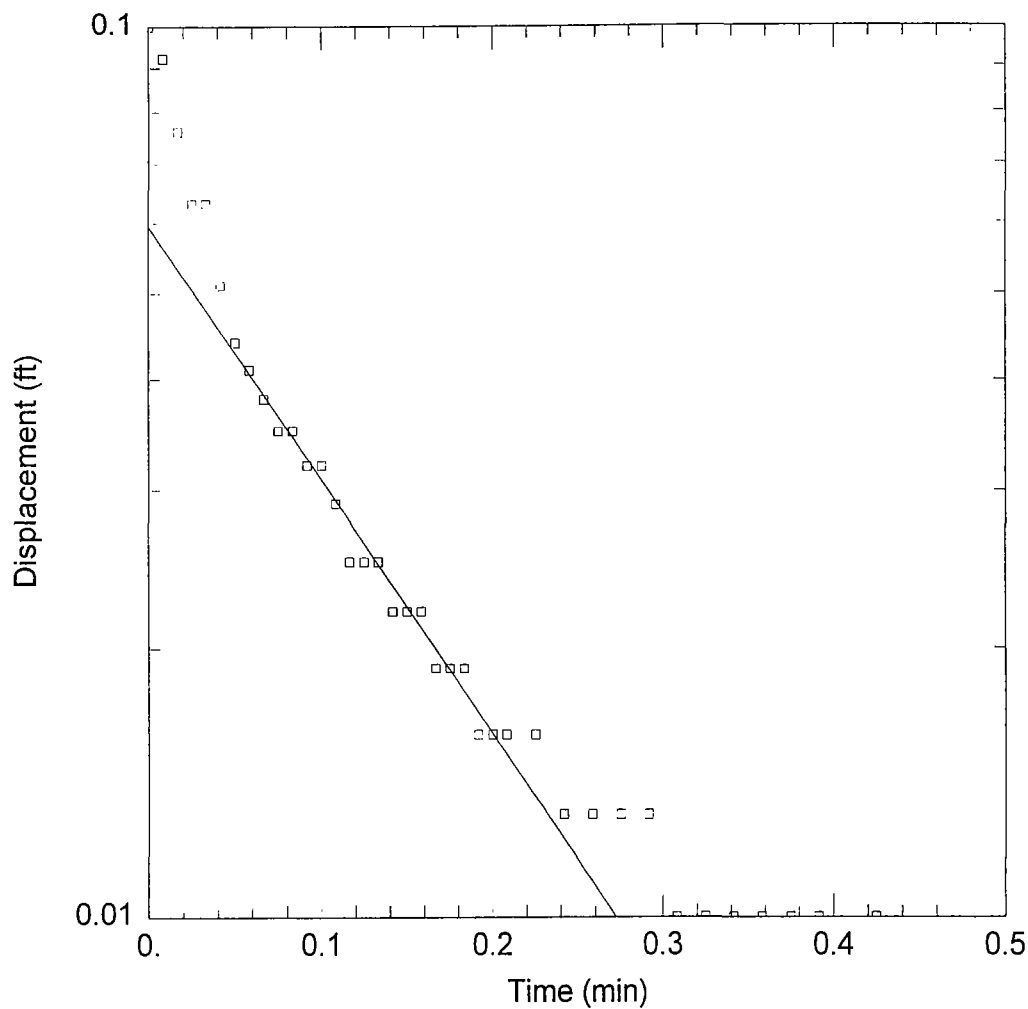
Ground Elevation : 577.22 Feet
Subcontractor : Toltest

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PID (ppm)	% Recovery	Well: CMS-MW18 Elev.: 580.02' TOC Cover	Well Construction Information
0	Not sampled. Concrete and brick fill to 4'.						WELL CONSTRUCTION Date Compl. : 8/18/99 Hole Diameter : 8.25" Drill. Method : HSA Parsons ES Rep. : M. Pawlyk WELL RISER Material : SS Diameter : 2 in. Joints : threaded WELL SCREEN Material : SS Diameter : 2 in. Joints : threaded Opening : .010 slot Length : 5' SAND PACK : Silica filter sand ANNULUS SEAL : bentonite chips NOTES 6 bags of 50 lbs. filter sand. 3 bags of 50 lbs. bentonite chips. 2' X 2' concrete well pad at surface. Stick-up protective casing - 6" diameter.
1				0.0	0		
2		FILL					
3				0.0	0		
4	Lt. gray cse. sand, some gravel, med. dense, moist to wet.			0.0	70		
5							
6		FILL					
7				0.0	70		
8							
9				0.0	70		
10	Grayish yellow green, fine to med. clayey sand, loose, wet.	FILL					
11	Sandy peat, some clay, soft, wet.	PT		0.0	70		
12	No recovery.						
13		NA		0.0	0		
14							
15	Gray silty to sandy clay, trace white fine-grained putty-like substance, med. stiff wet.	FILL		0.0	50		
16							
17							
18							
19							
20							
21							
22							

Checked by: WLB

c:\project\1a-to-f\basf\cmsrep ~ 1\boring ~ 1\cms-mw18.bor

03-20-2000



BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS01O.AQT

Date: 02/22/00

Time: 11:05:37

AQUIFER DATA

Saturated Thickness: 1.65 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 0.1 ft

Water Column Height: 1.65 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 2. ft

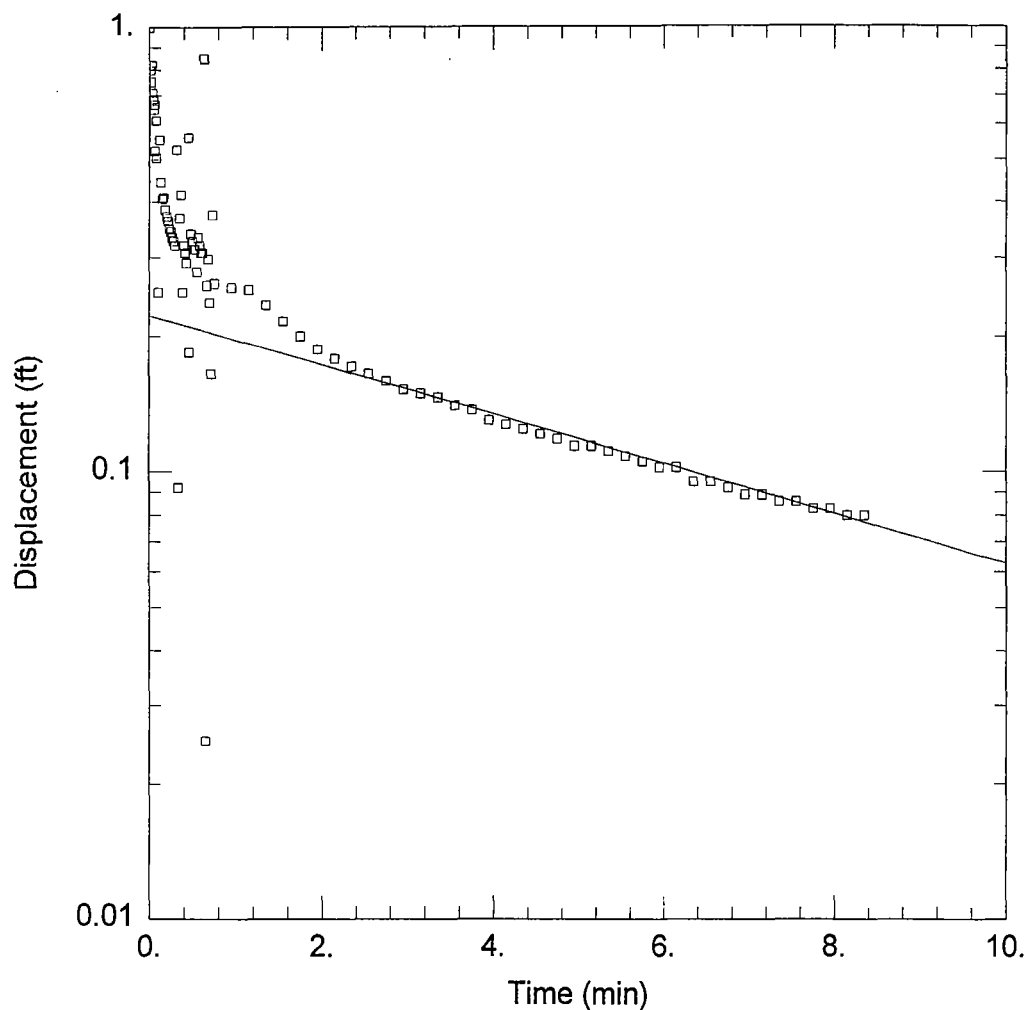
SOLUTION

Aquifer Model: Unconfined

$K = 0.006652$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.05945$ ft



BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS02I.AQT

Date: 02/12/00

Time: 15:10:55

AQUIFER DATA

Saturated Thickness: 5.6 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1. ft

Water Column Height: 5.6 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 5. ft

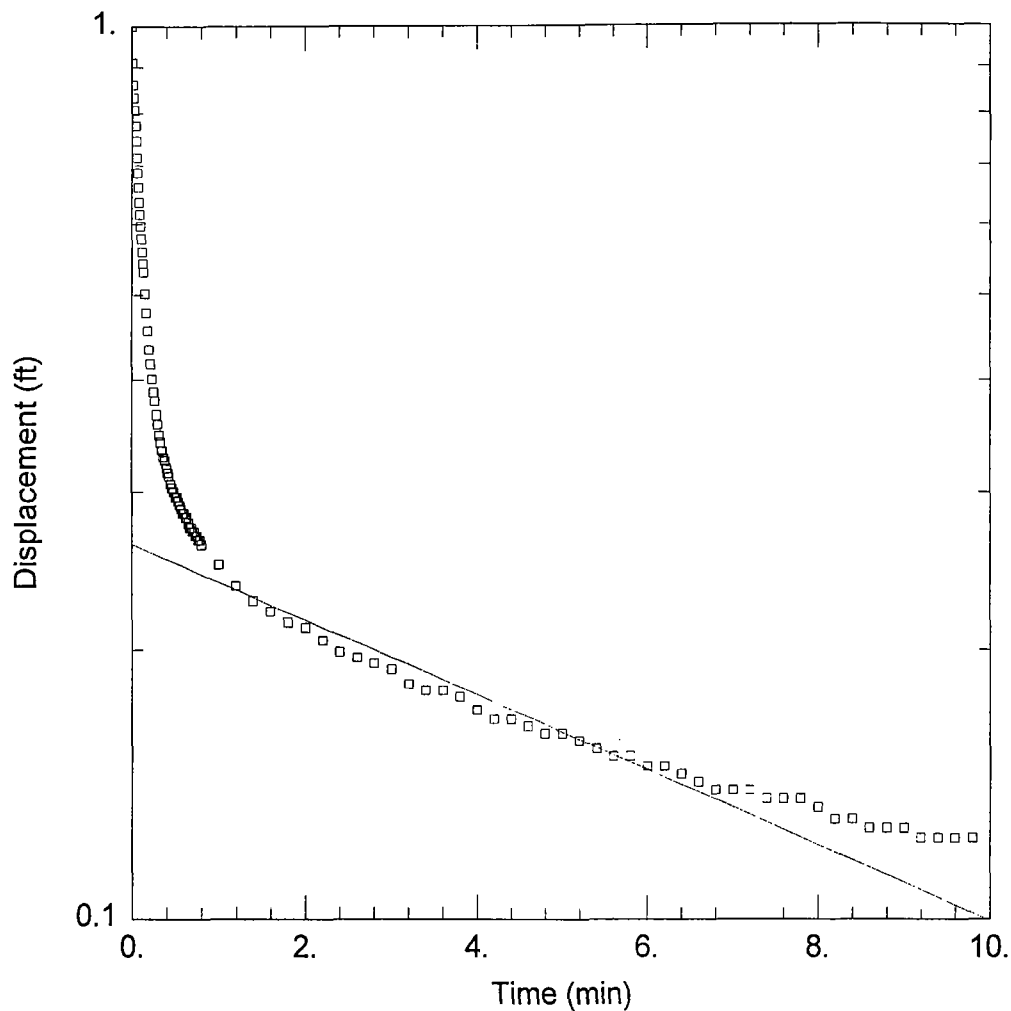
SOLUTION

Aquifer Model: Unconfined

$K = 8.989\text{E-}05$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.2225$ ft



CMS-MW02, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS02O.AQT

Date: 02/12/00

Time: 14:05:28

AQUIFER DATA

Saturated Thickness: 5.6 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1. ft

Water Column Height: 5.6 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 5. ft

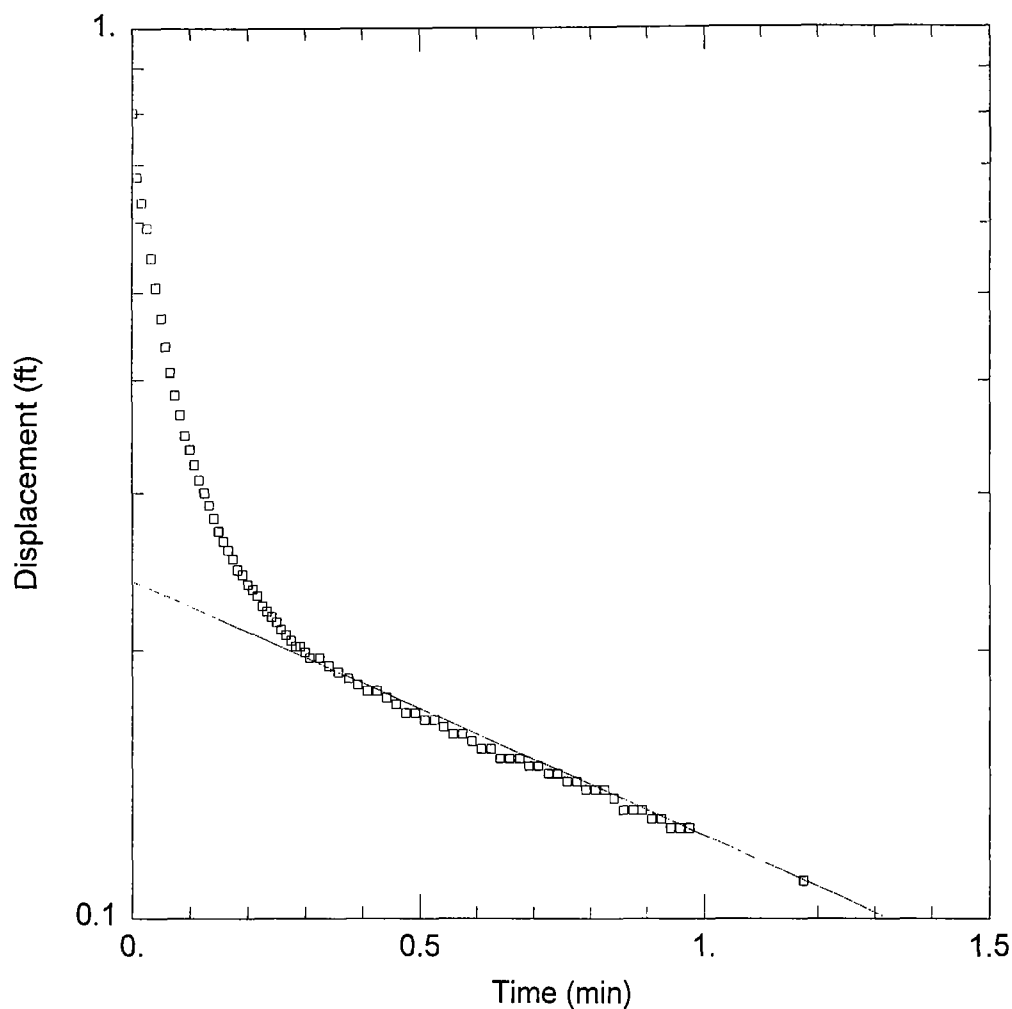
SOLUTION

Aquifer Model: Unconfined

$K = 6.881E-05$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.2623$ ft



CMS-MW03, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS03O.AQT

Date: 02/12/00

Time: 14:05:35

AQUIFER DATA

Saturated Thickness: 2.7 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 0.8 ft

Water Column Height: 2.7 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 2. ft

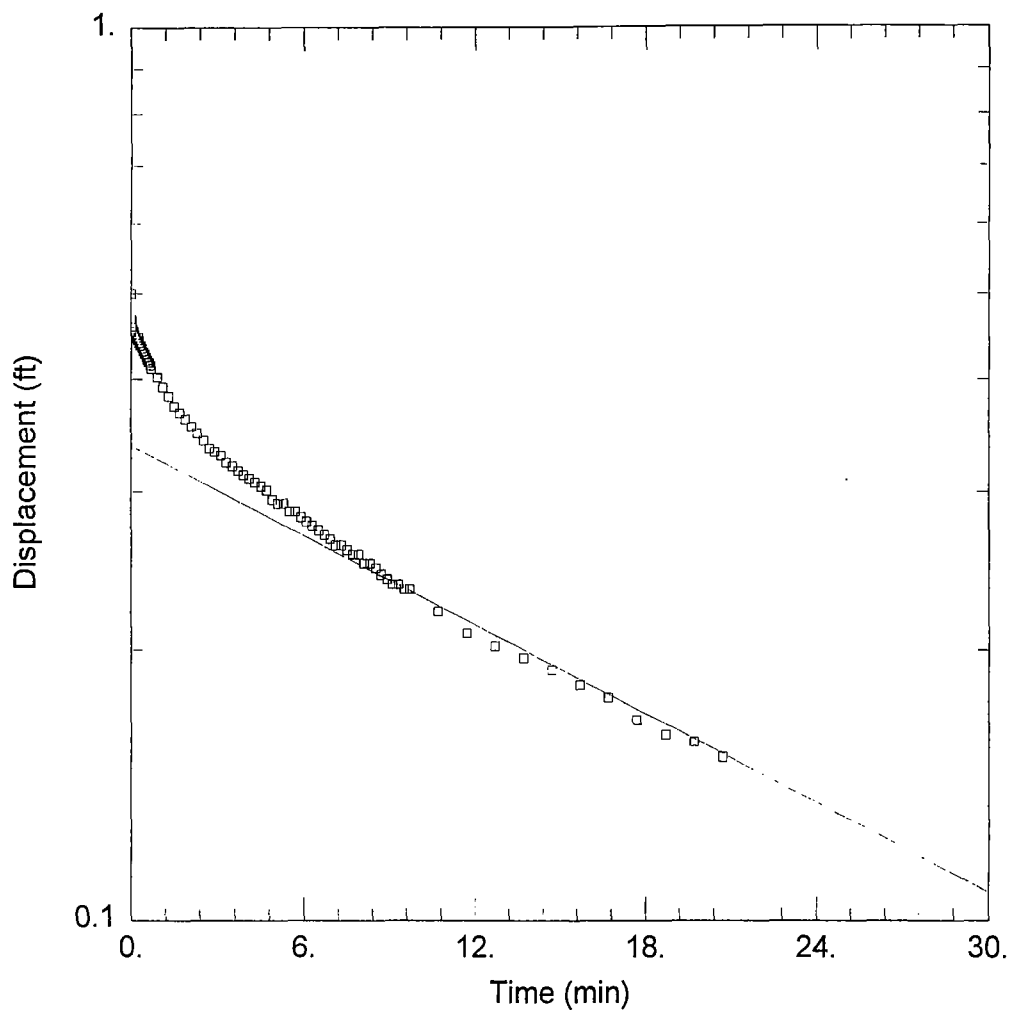
SOLUTION

Aquifer Model: Unconfined

$K = 0.0008299$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.2391$ ft



CMS-MW05, BASF, 08/99

Data Set: E:\PROJECT\A-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS05I.AQT

Date: 02/22/00

Time: 10:05:01

AQUIFER DATA

Saturated Thickness: 6. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 0.5 ft

Water Column Height: 6. ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 7. ft

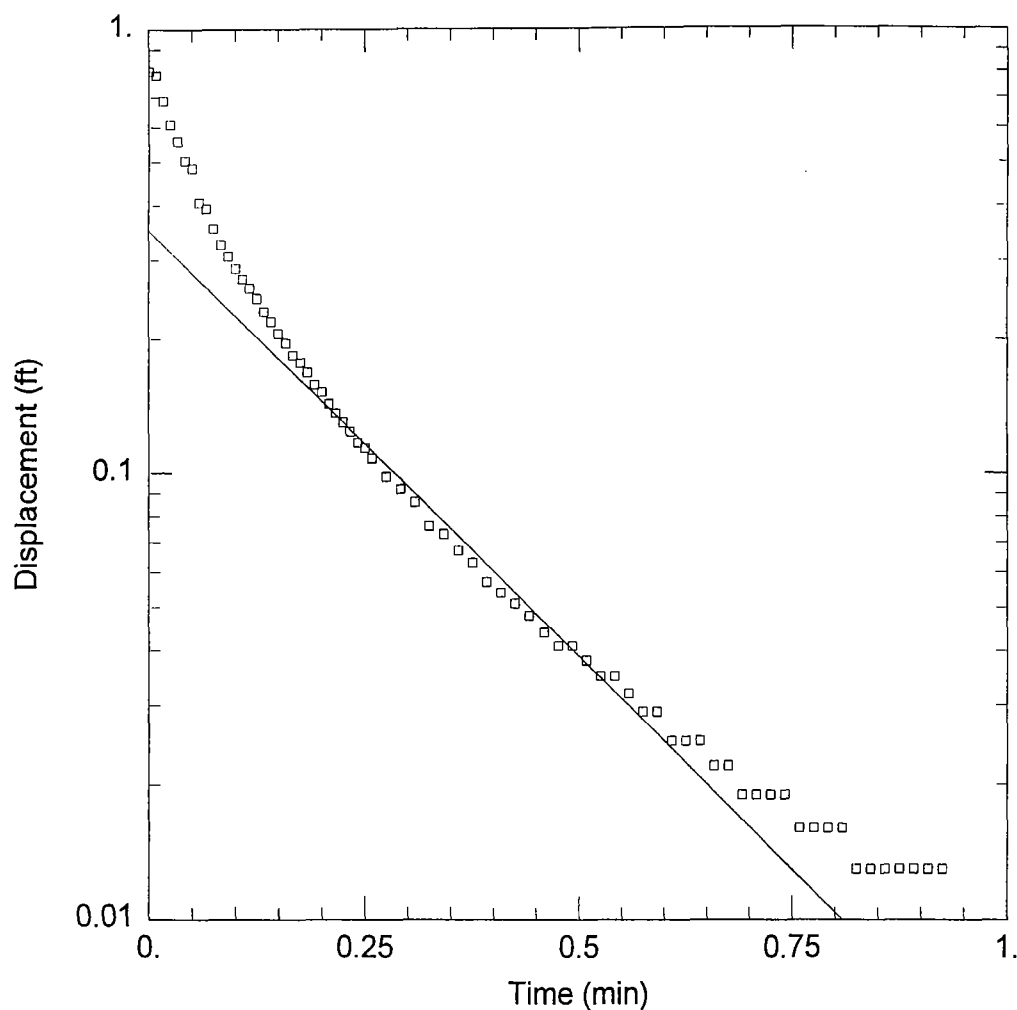
SOLUTION

Aquifer Model: Unconfined

$K = 2.054E-05$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.3371$ ft



CMS-MW06, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS06O.AQT

Date: 02/12/00

Time: 14:05:46

AQUIFER DATA

Saturated Thickness: 6.5 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 0.8 ft

Water Column Height: 6.5 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 5. ft

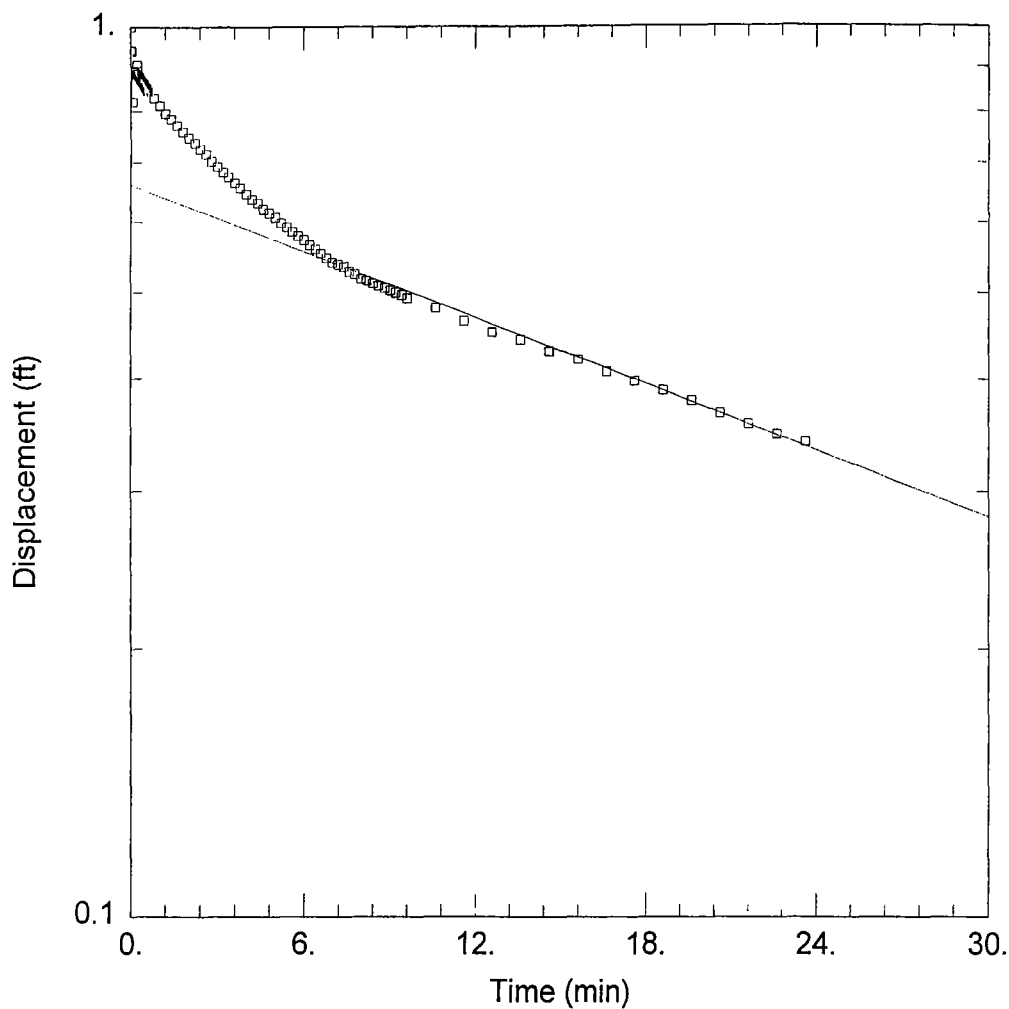
SOLUTION

Aquifer Model: Unconfined

K = 0.003258 cm/sec

Solution Method: Bouwer-Rice

y_0 = 0.3503 ft



CMS-MW07, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS07I.AQT

Date: 02/12/00

Time: 14:05:52

AQUIFER DATA

Saturated Thickness: 4.1 ft

Anisotropy Ratio (K_z/K_r): 1

WELL DATA

Initial Displacement: 1 ft

Water Column Height: 4.1 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 2 ft

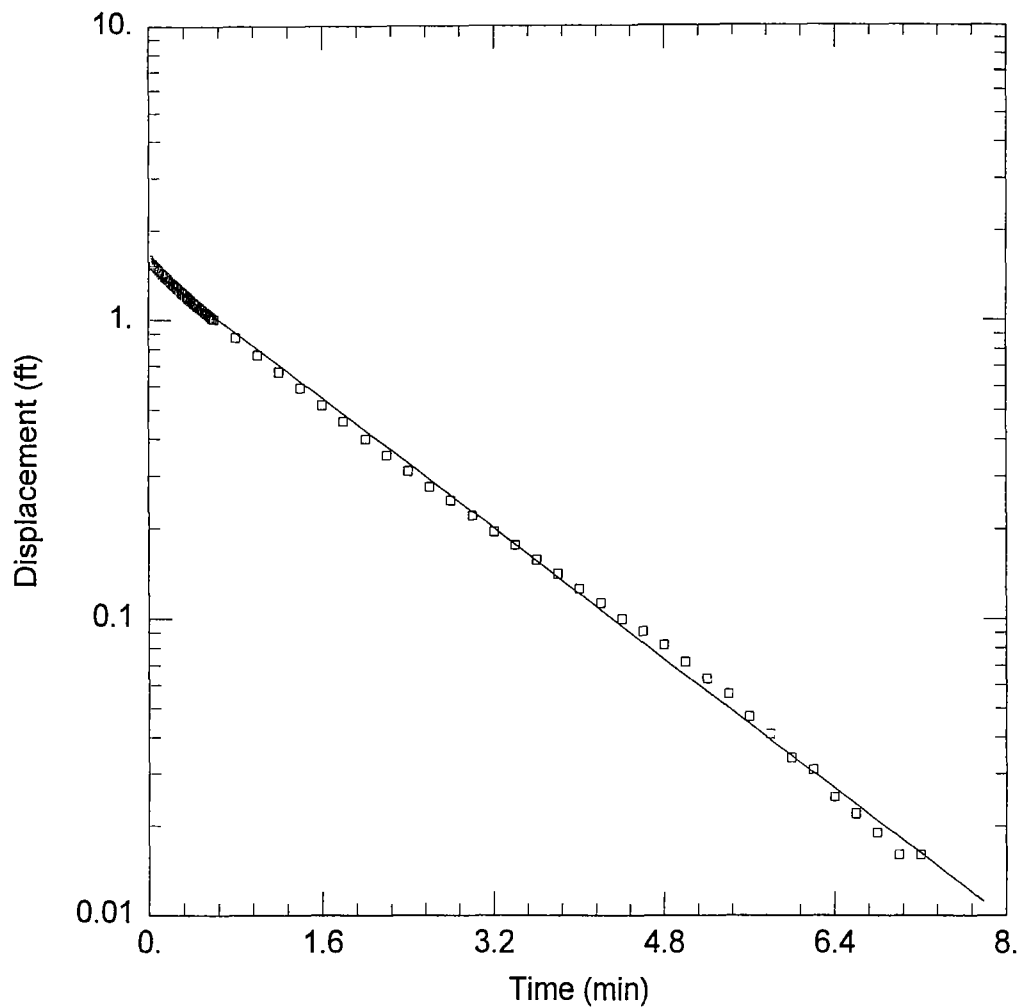
SOLUTION

Aquifer Model: Unconfined

$K = 4.111E-05$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.6597$ ft



CMS-MW08, BASF, 08/99

Data Set: E:\PROJECT\A-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS08I.AQT

Date: 02/12/00

Time: 14:05:57

AQUIFER DATA

Saturated Thickness: 6.1 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1.6 ft

Water Column Height: 6.1 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 4. ft

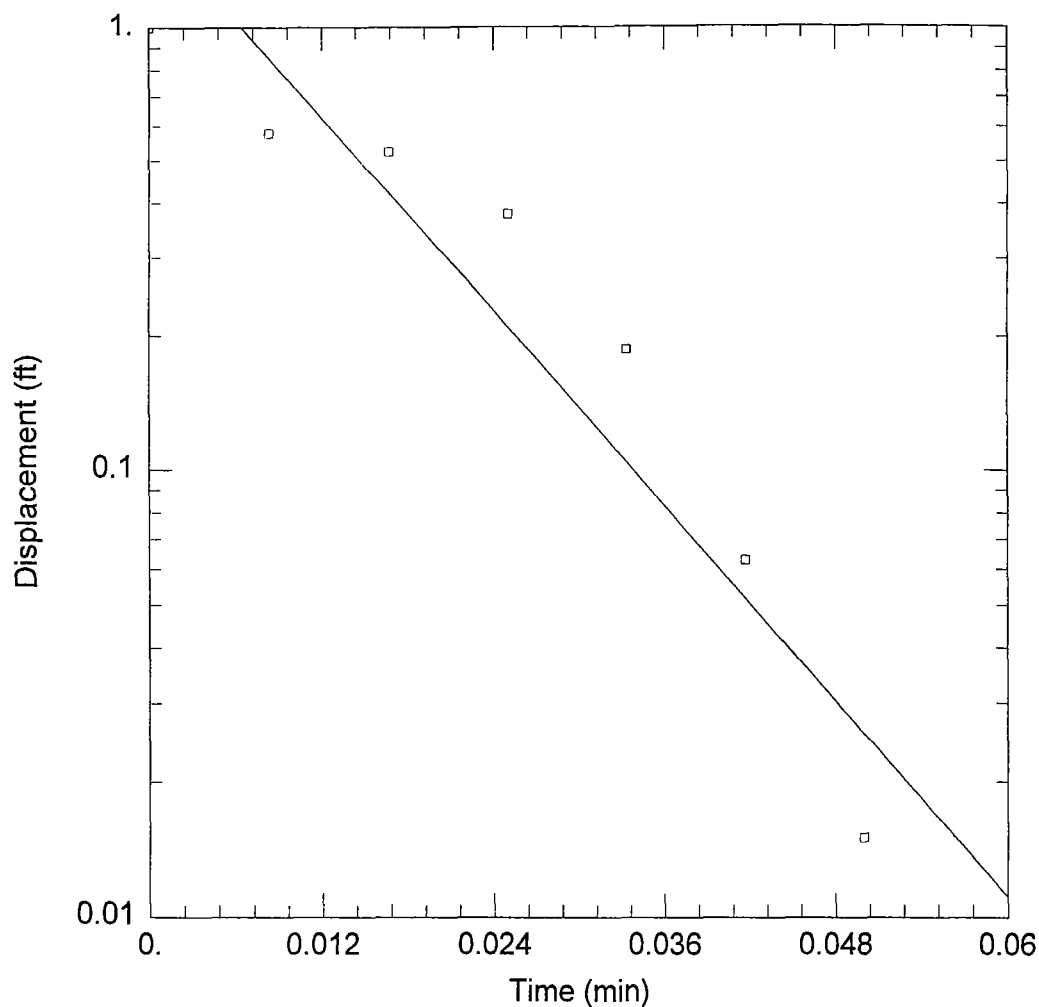
SOLUTION

Aquifer Model: Unconfined

$K = 0.0005541$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.499$ ft



CMS-MW09, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS09O.AQT

Date: 02/12/00

Time: 14:06:03

AQUIFER DATA

Saturated Thickness: 12.5 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1. ft

Water Column Height: 12.5 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 10. ft

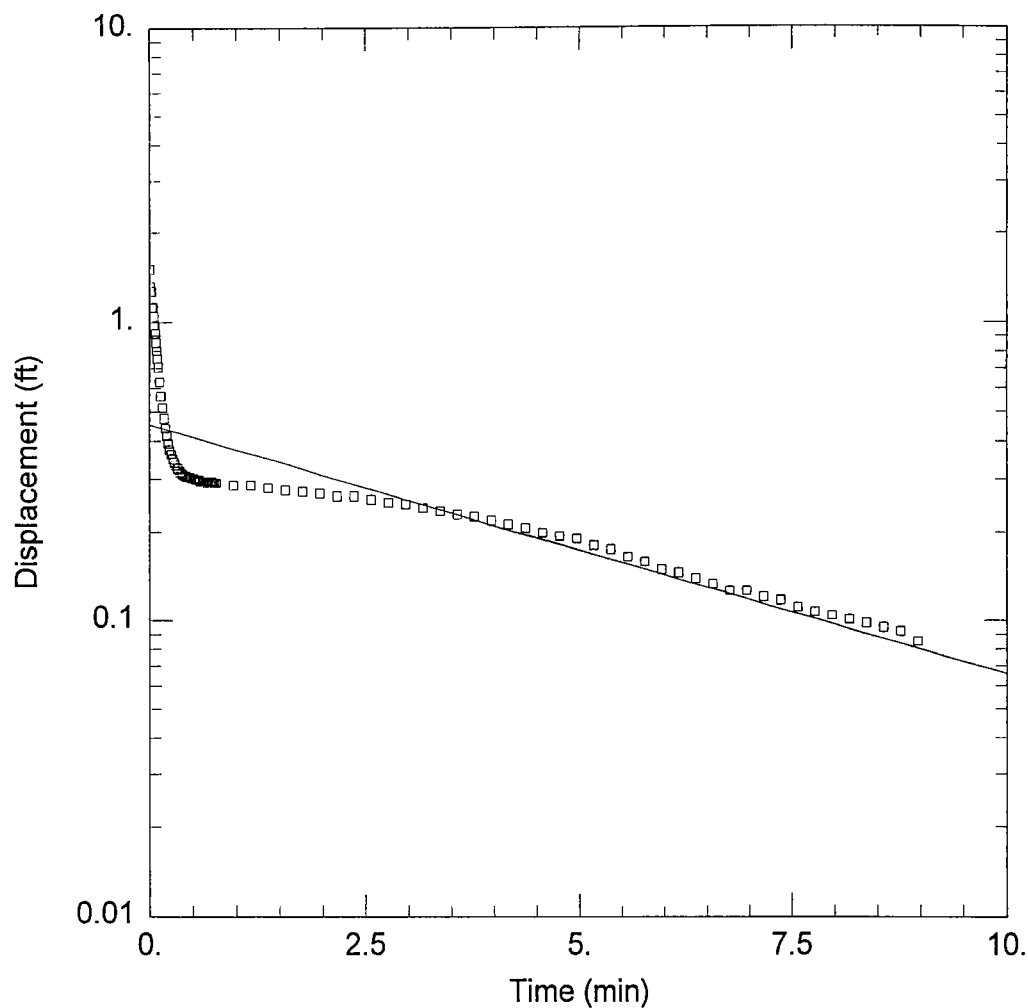
SOLUTION

Aquifer Model: Unconfined

$K = 0.03971$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.714$ ft



CMS-MW10, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS10I.AQT

Date: 02/12/00

Time: 14:06:13

AQUIFER DATA

Saturated Thickness: 6.1 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1.5 ft

Water Column Height: 6.1 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 5. ft

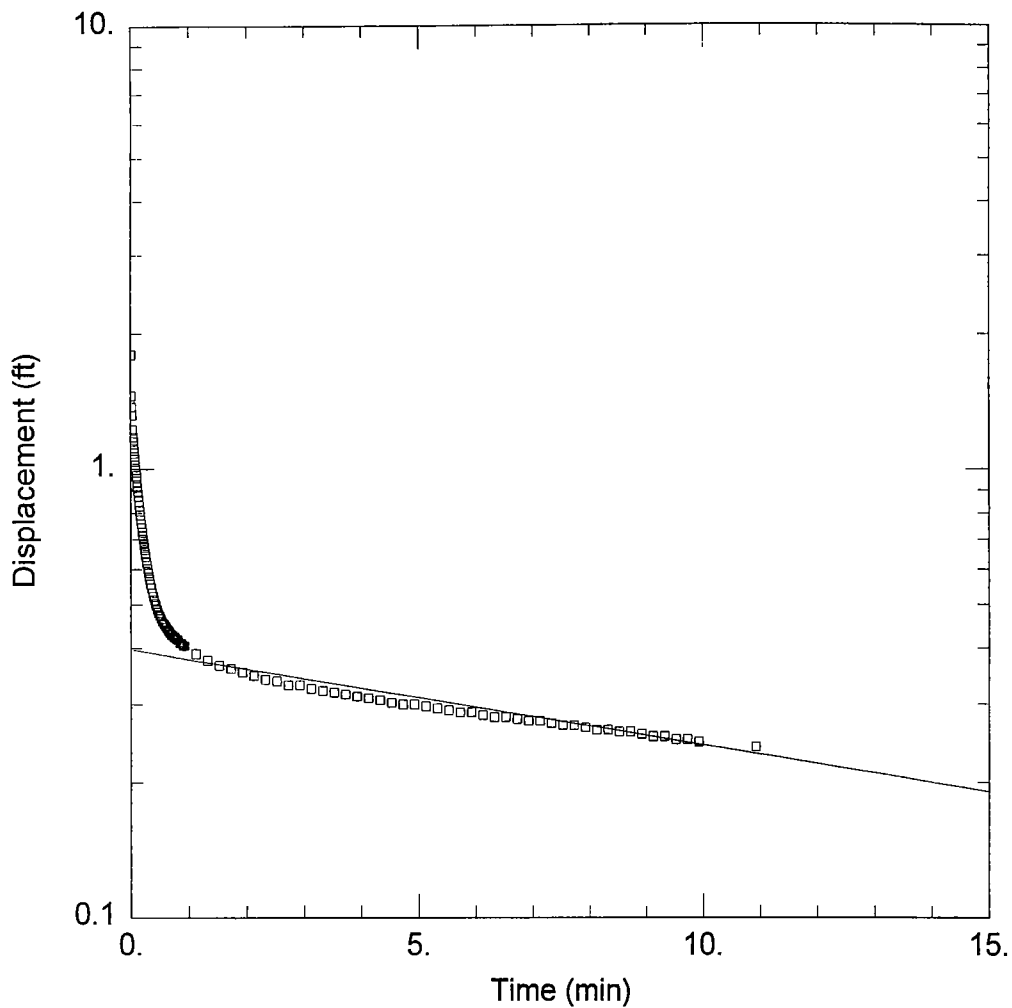
SOLUTION

Aquifer Model: Unconfined

$K = 0.0001403$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.4528$ ft



CMS-MW11, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS11I.AQT

Date: 02/12/00

Time: 18:28:26

AQUIFER DATA

Saturated Thickness: 10. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1.8 ft

Water Column Height: 10. ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 10. ft

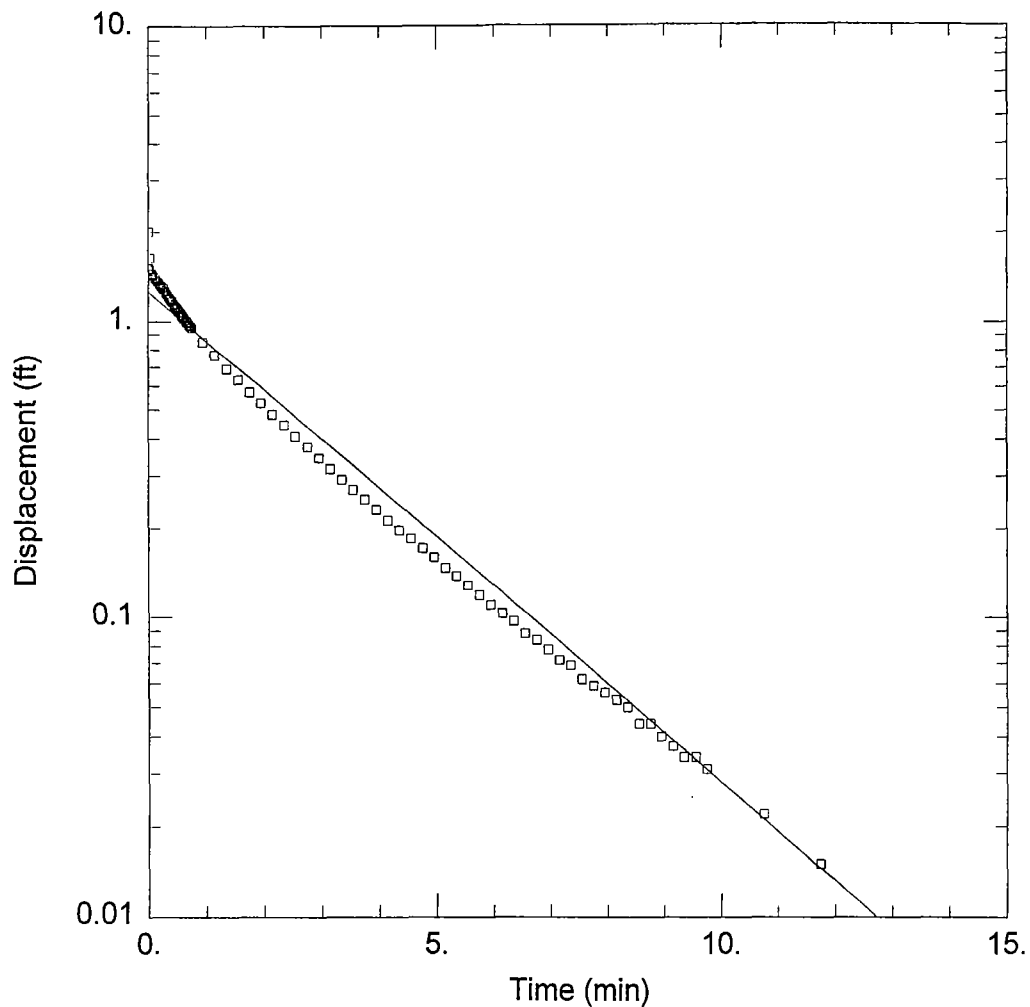
SOLUTION

Aquifer Model: Unconfined

$K = 2.196E-05$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.3969$ ft



CMS-MW12, BASF, 08/99

Data Set: E:\PROJECT\A-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS12I.AQT

Date: 02/12/00

Time: 14:06:26

AQUIFER DATA

Saturated Thickness: 6.1 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 2. ft

Water Column Height: 6.1 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 5. ft

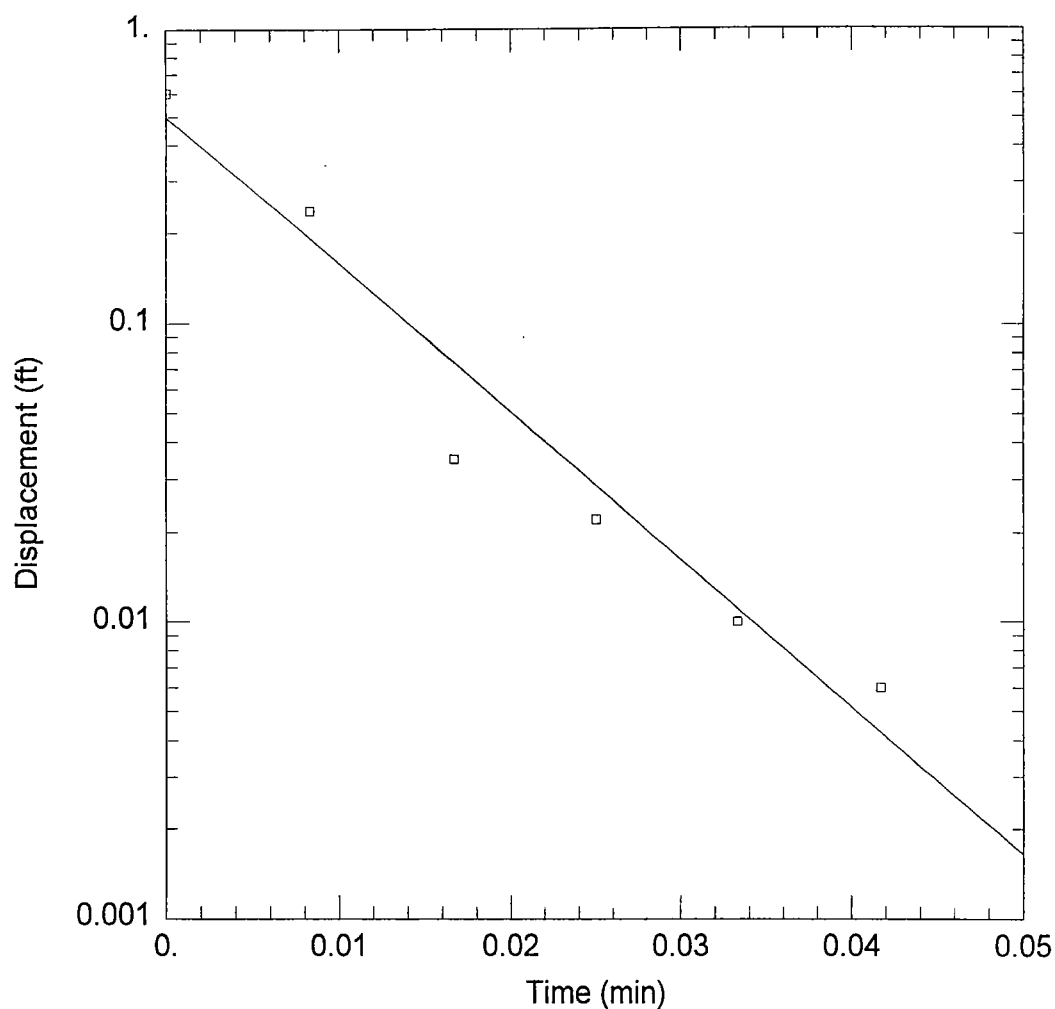
SOLUTION

Aquifer Model: Unconfined

$K = 0.0002762$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.254$ ft



CMS-MW13F, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS13FO.AQT

Date: 02/12/00

Time: 14:06:34

AQUIFER DATA

Saturated Thickness: 4.15 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 0.6 ft

Water Column Height: 4.15 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 2. ft

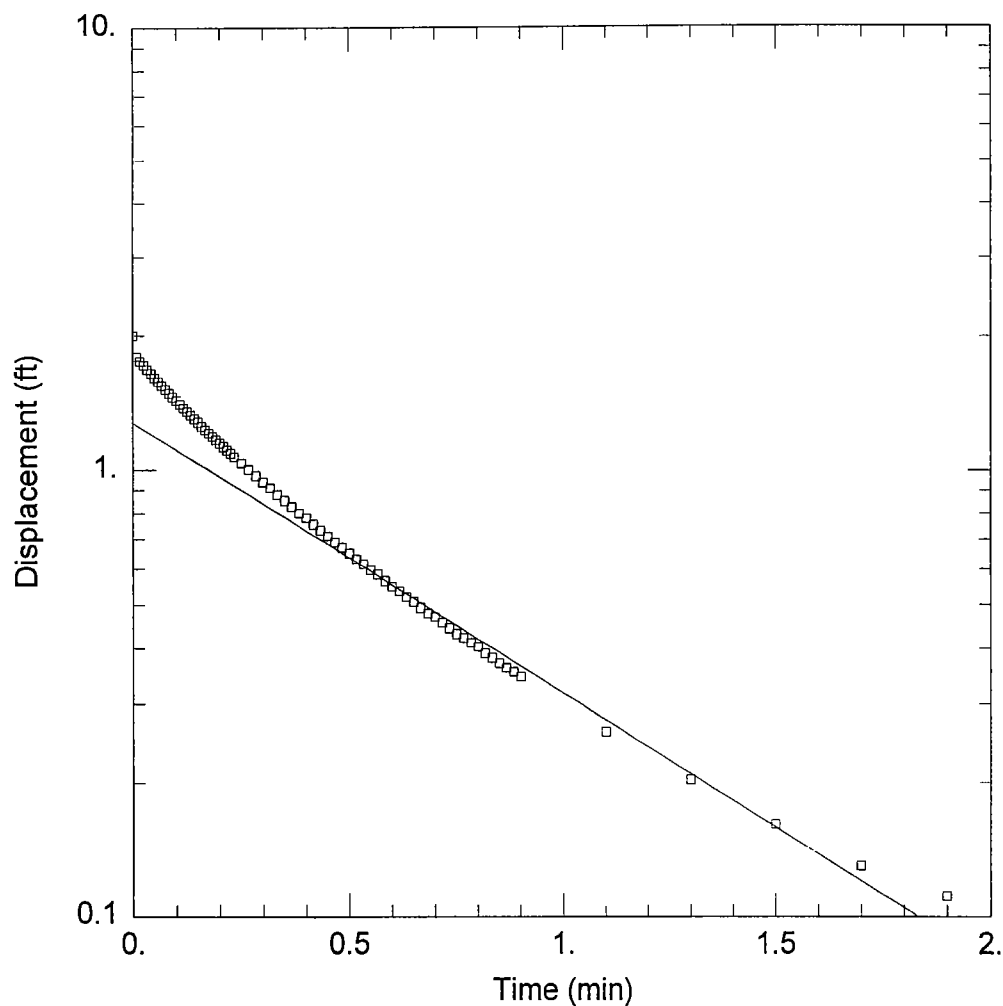
SOLUTION

Aquifer Model: Unconfined

$K = 0.1657$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.4962$ ft



CMS-MW13S, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS13SO.AQT

Date: 02/12/00

Time: 14:06:42

AQUIFER DATA

Saturated Thickness: 11. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 2. ft

Water Column Height: 12.2 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 7. ft

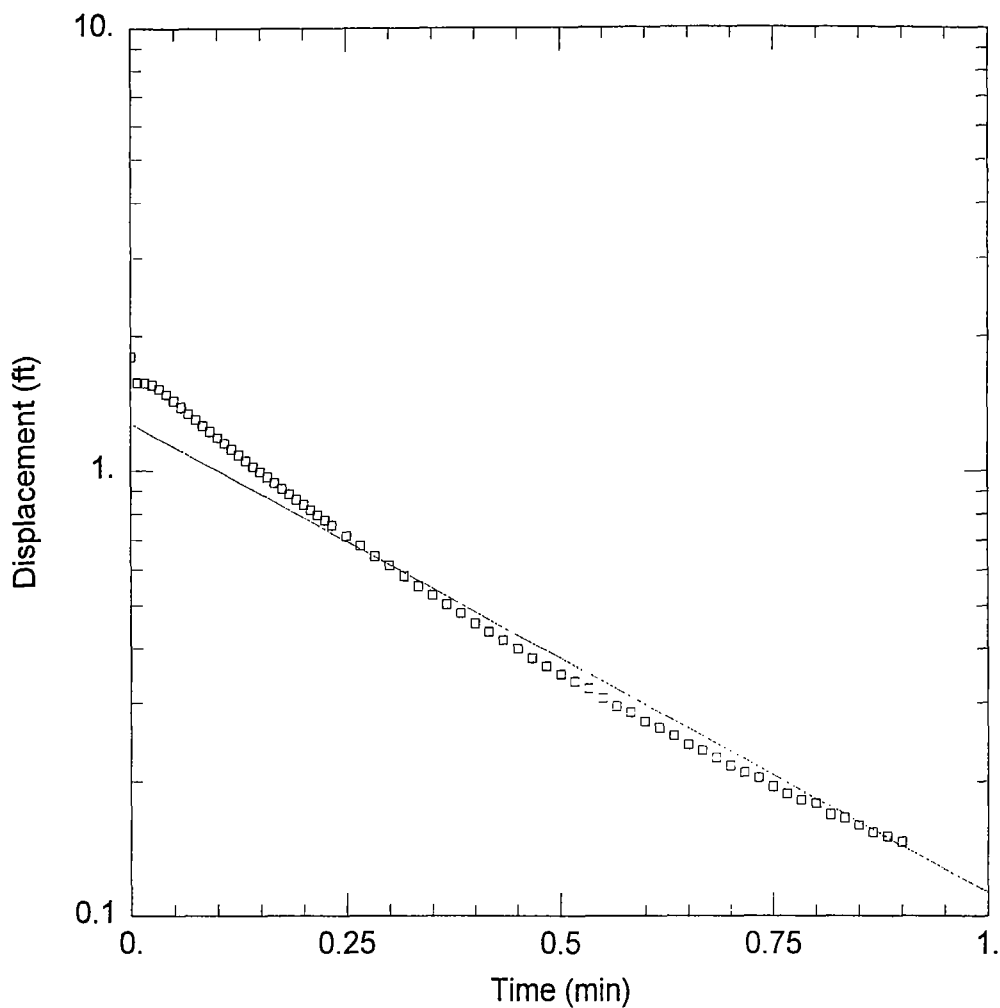
SOLUTION

Aquifer Model: Confined

$K = 0.0008962$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.275$ ft



CMS-MW14S, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS14SO.AQT

Date: 02/12/00

Time: 14:06:51

AQUIFER DATA

Saturated Thickness: 8. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1.8 ft

Water Column Height: 8. ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 7. ft

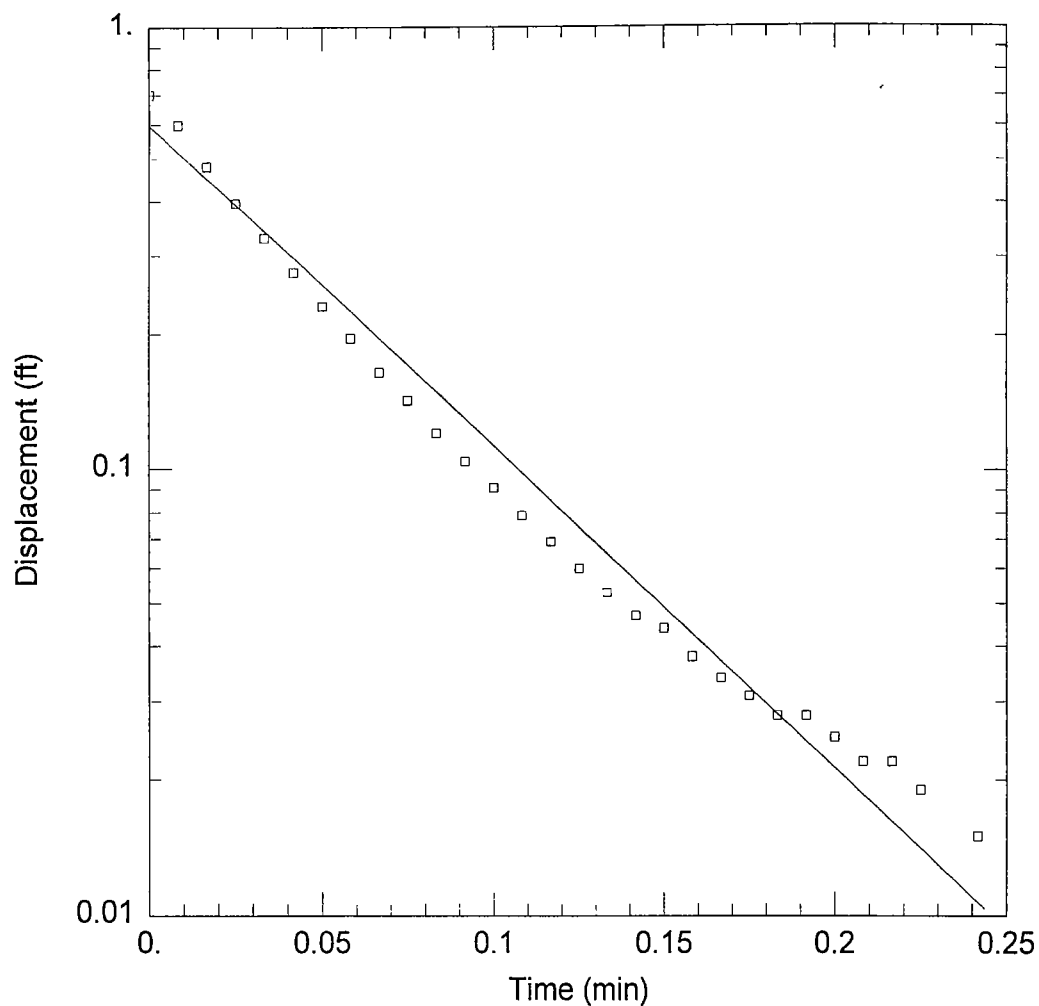
SOLUTION

Aquifer Model: Confined

$K = 0.001413$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.275$ ft



CMS-MW15, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS15O.AQT

Date: 02/12/00

Time: 14:07:09

AQUIFER DATA

Saturated Thickness: 5.79 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 0.7 ft

Water Column Height: 5.79 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 5. ft

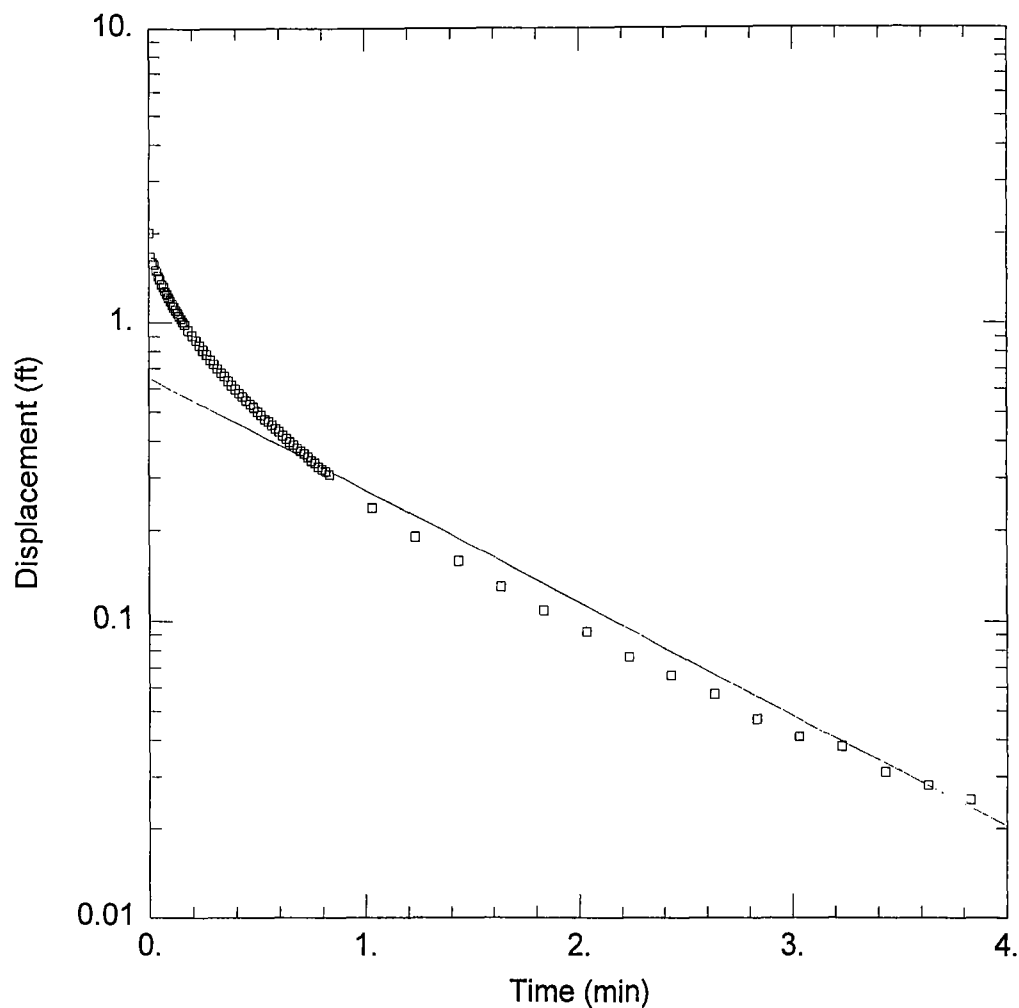
SOLUTION

Aquifer Model: Unconfined

$K = 0.01193$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.5946$ ft



CMS-MW16, BASF, 08/99

Data Set: E:\PROJECT\A-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS16O.AQT

Date: 02/12/00

Time: 14:07:18

AQUIFER DATA

Saturated Thickness: 9.47 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 2. ft

Water Column Height: 9.47 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 5. ft

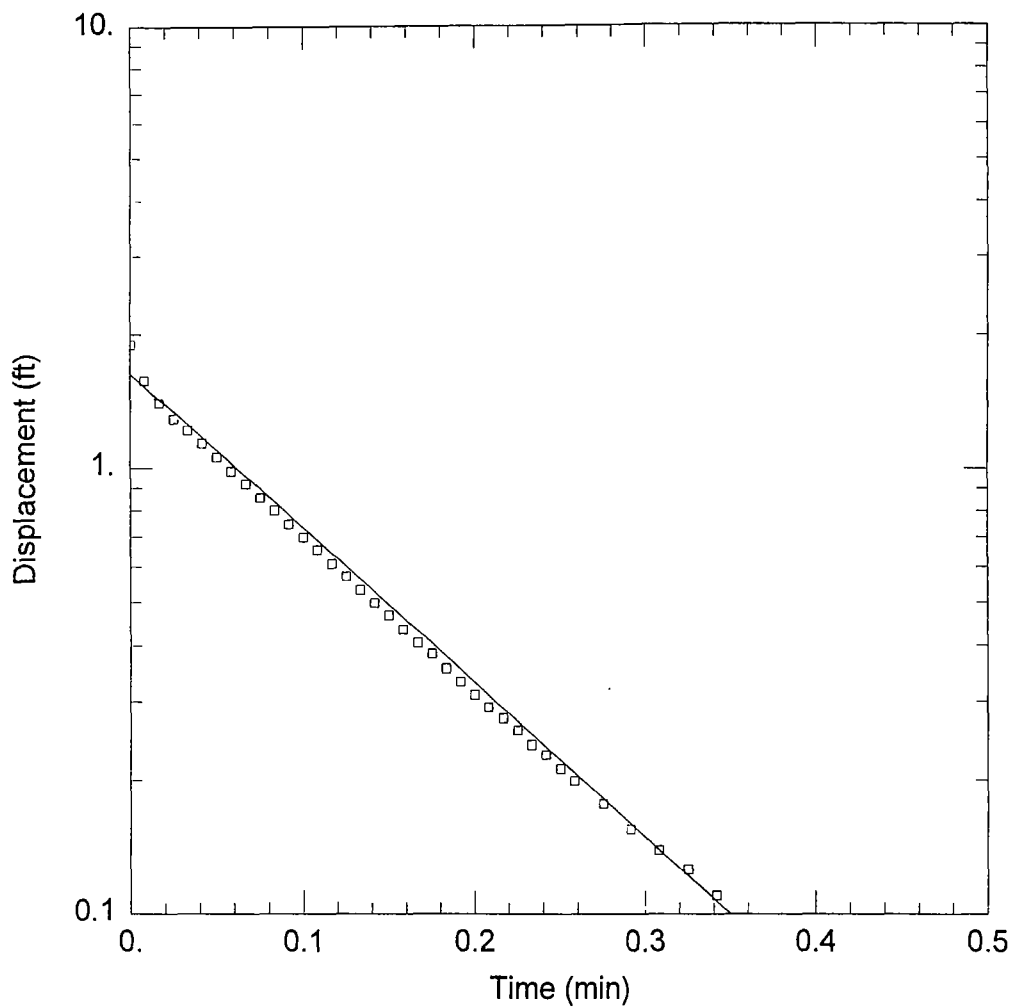
SOLUTION

Aquifer Model: Unconfined

$K = 0.0007038$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.6494$ ft



CMS-MW18, BASF, 08/99

Data Set: E:\PROJECT\A-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FCMS18O.AQT

Date: 02/12/00

Time: 14:07:25

AQUIFER DATA

Saturated Thickness: 9.65 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1.9 ft

Water Column Height: 9.65 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.344 ft

Screen Length: 5. ft

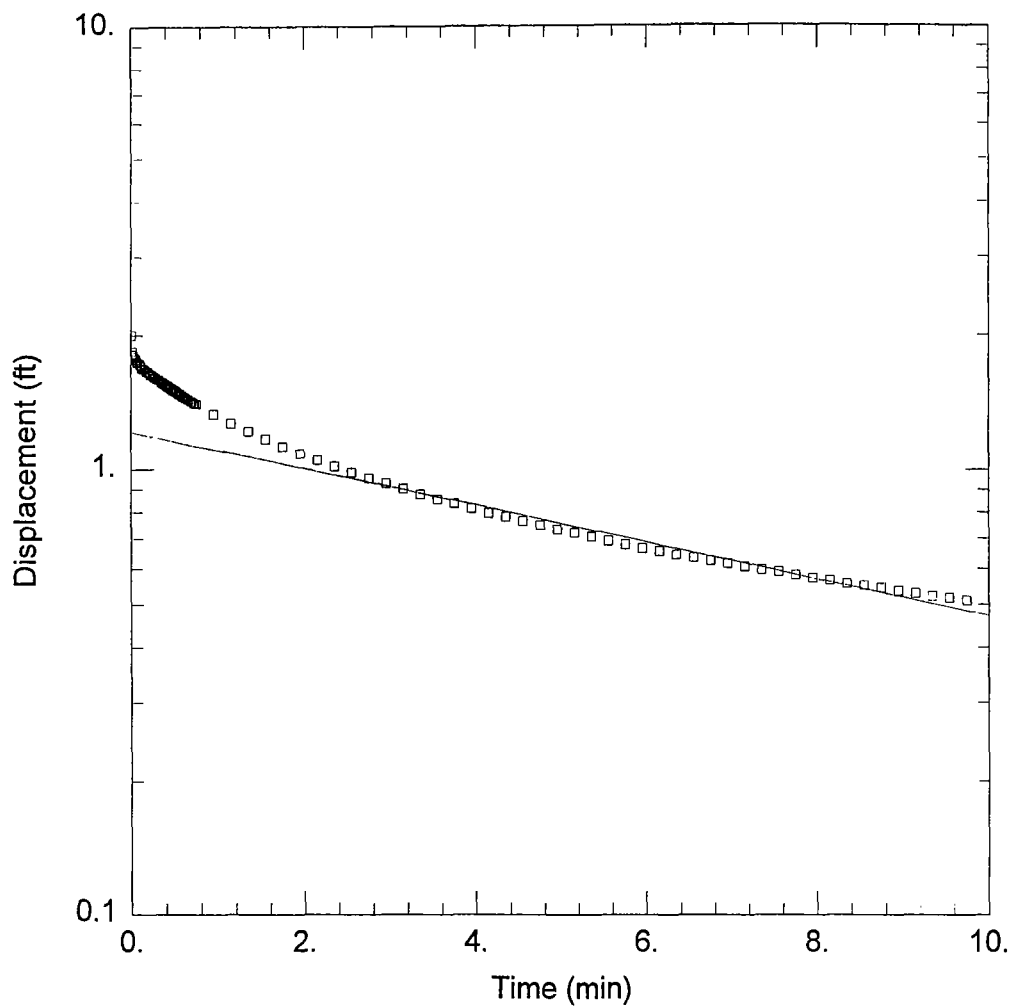
SOLUTION

Aquifer Model: Unconfined

$K = 0.006516$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.633$ ft



PM4NA, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FPM4NAI.AQT
 Date: 02/12/00 Time: 14:07:32

AQUIFER DATA

Saturated Thickness: 20. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

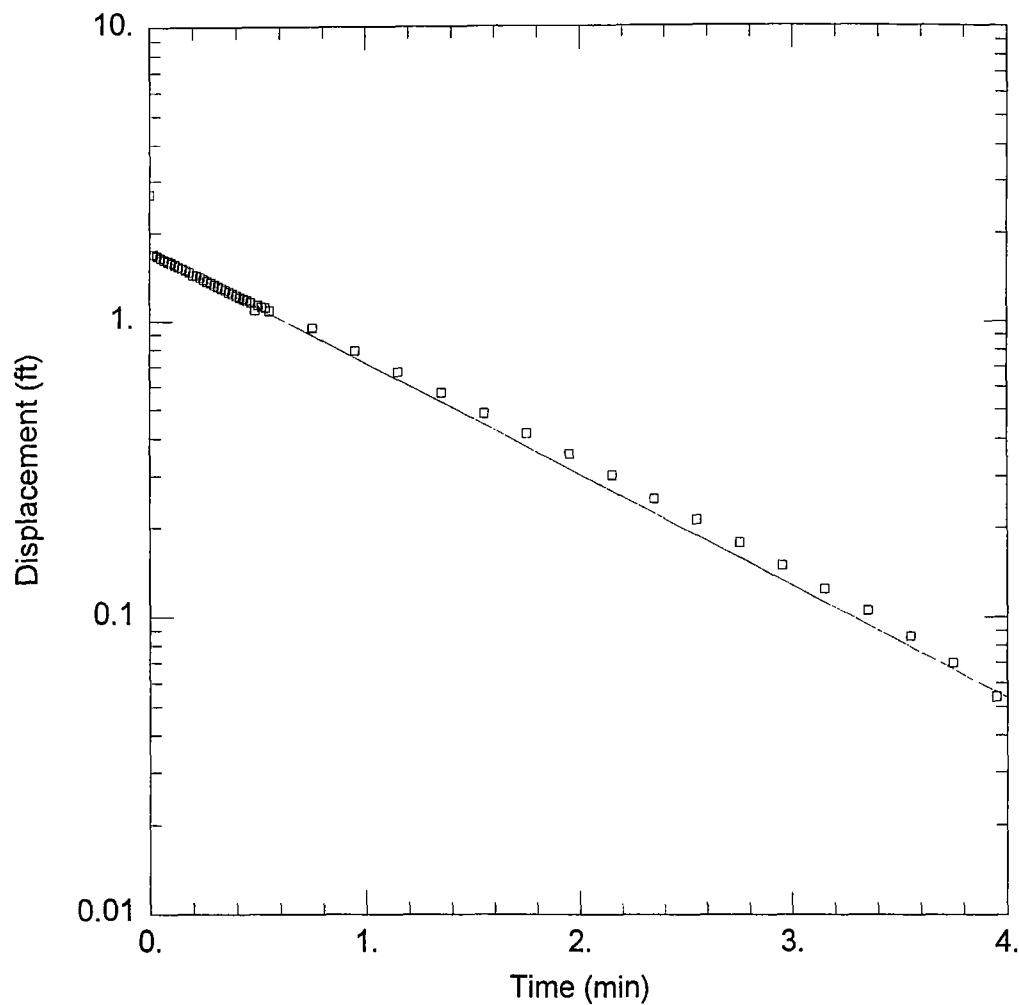
Initial Displacement: 2. ft
 Casing Radius: 0.0833 ft
 Screen Length: 5. ft

Water Column Height: 18.7 ft
 Wellbore Radius: 0.344 ft

SOLUTION

Aquifer Model: Unconfined
 Solution Method: Bouwer-Rice

$K = 7.548E-05$ cm/sec
 $y_0 = 1.212$ ft



RFI-MW01, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\RFI011.AQT

Date: 02/12/00

Time: 14:07:39

AQUIFER DATA

Saturated Thickness: 11. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 2.7 ft

Water Column Height: 19.18 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

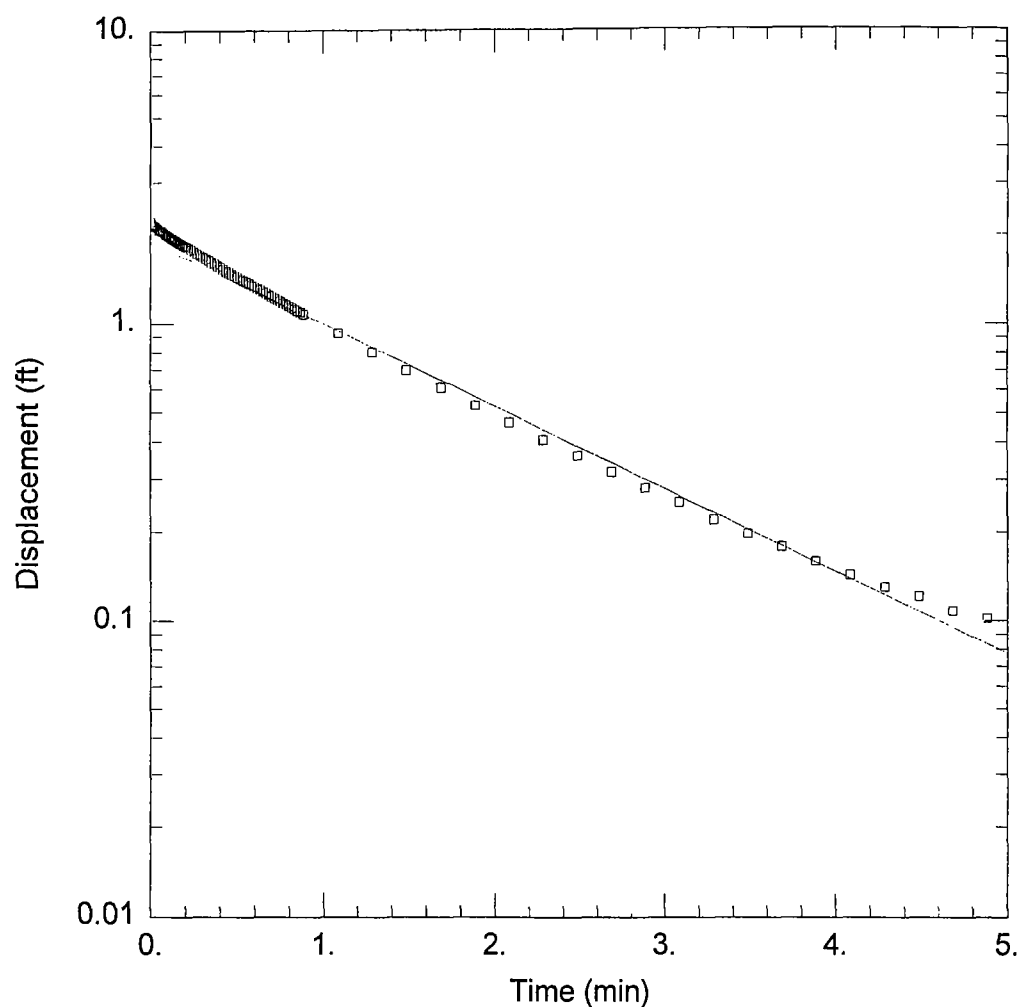
SOLUTION

Aquifer Model: Confined

$K = 0.001699$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.708$ ft



RFI-MW01, BASF, 08/99

Data Set: E:\PROJECT\A-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FRFI01O.AQT

Date: 02/12/00

Time: 14:08:05

AQUIFER DATA

Saturated Thickness: 11. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 2.2 ft

Water Column Height: 19.18 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

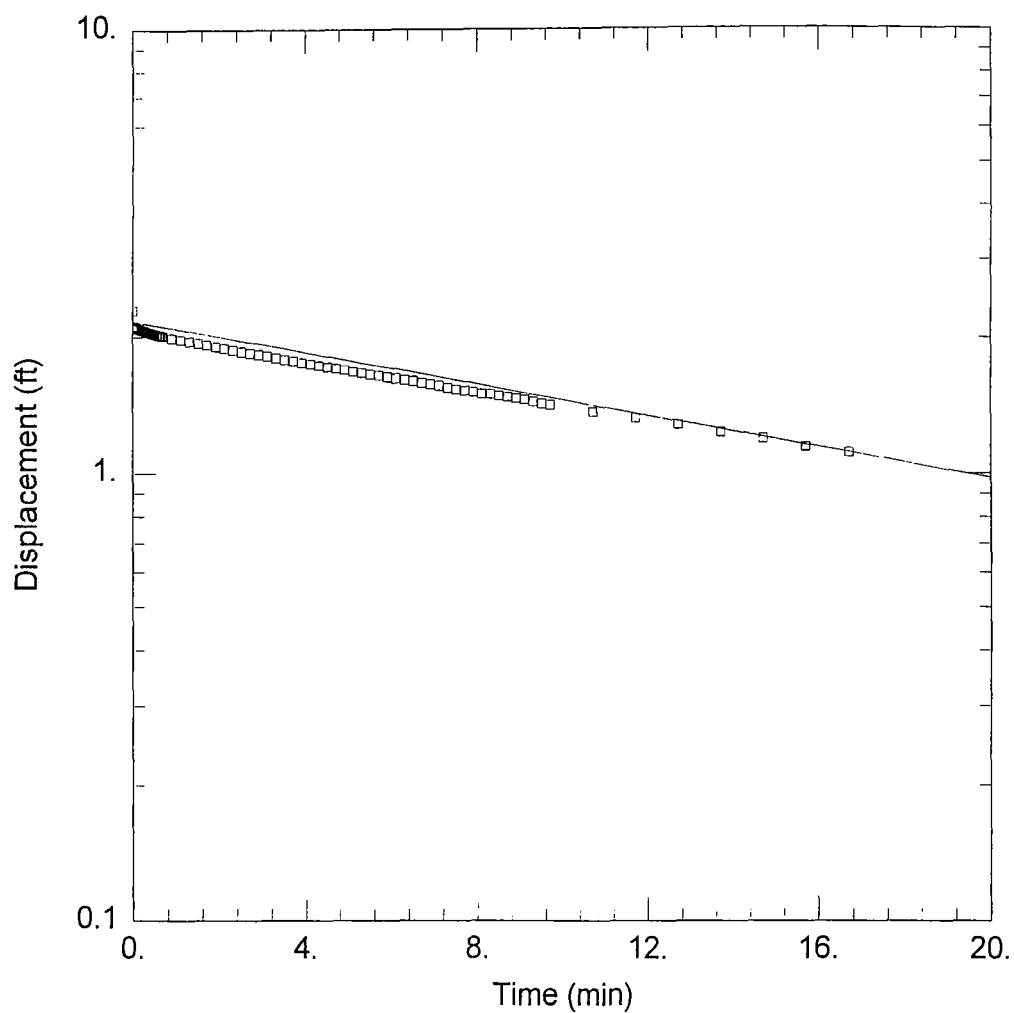
SOLUTION

Aquifer Model: Unconfined

$K = 0.001252$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.881$ ft



RFI-MW02, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\RFI02I.AQT

Date: 02/18/00

Time: 11:27:36

AQUIFER DATA

Saturated Thickness: 10. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 2.3 ft

Water Column Height: 23.4 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

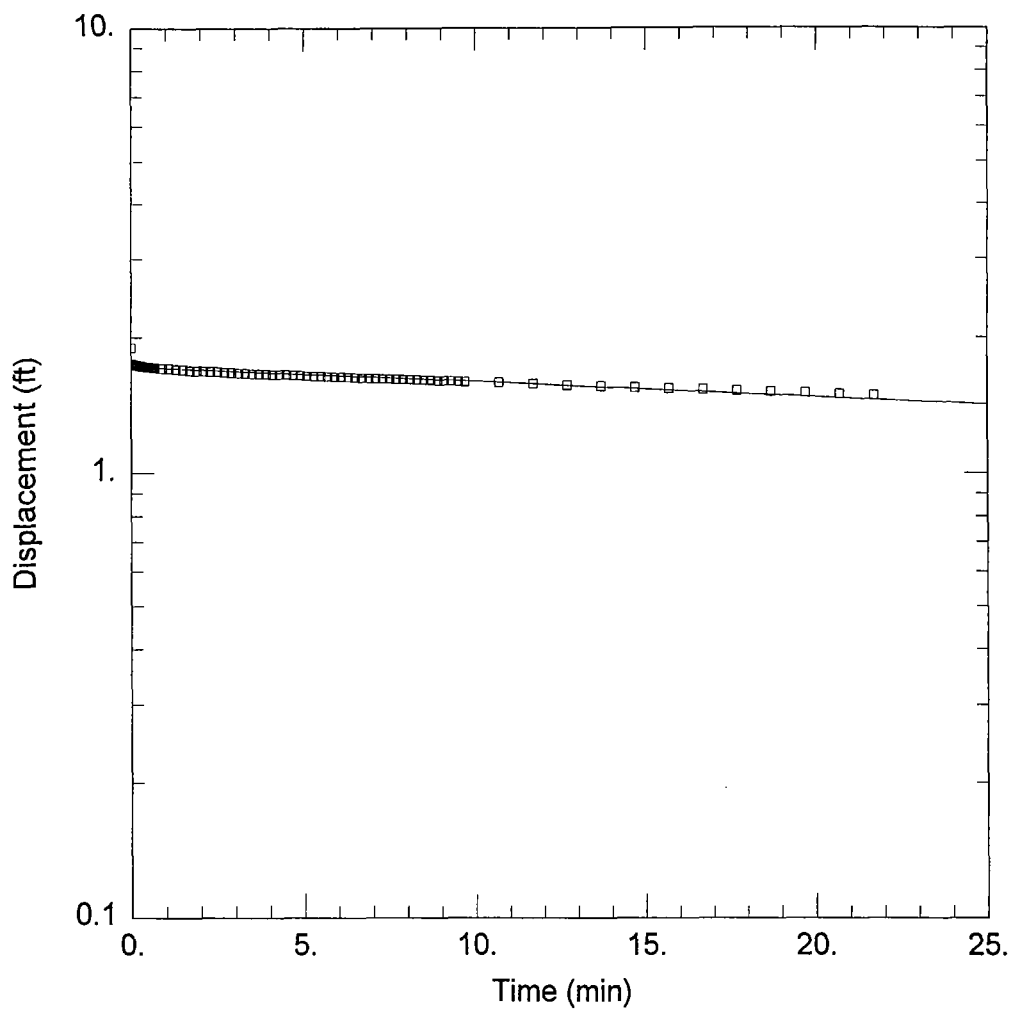
SOLUTION

Aquifer Model: Confined

$K = 8.081E-05$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 2.171$ ft



RFI-MW03, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FRFI03I.AQT

Date: 02/12/00

Time: 14:08:44

AQUIFER DATA

Saturated Thickness: 6. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1.9 ft

Water Column Height: 17.8 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

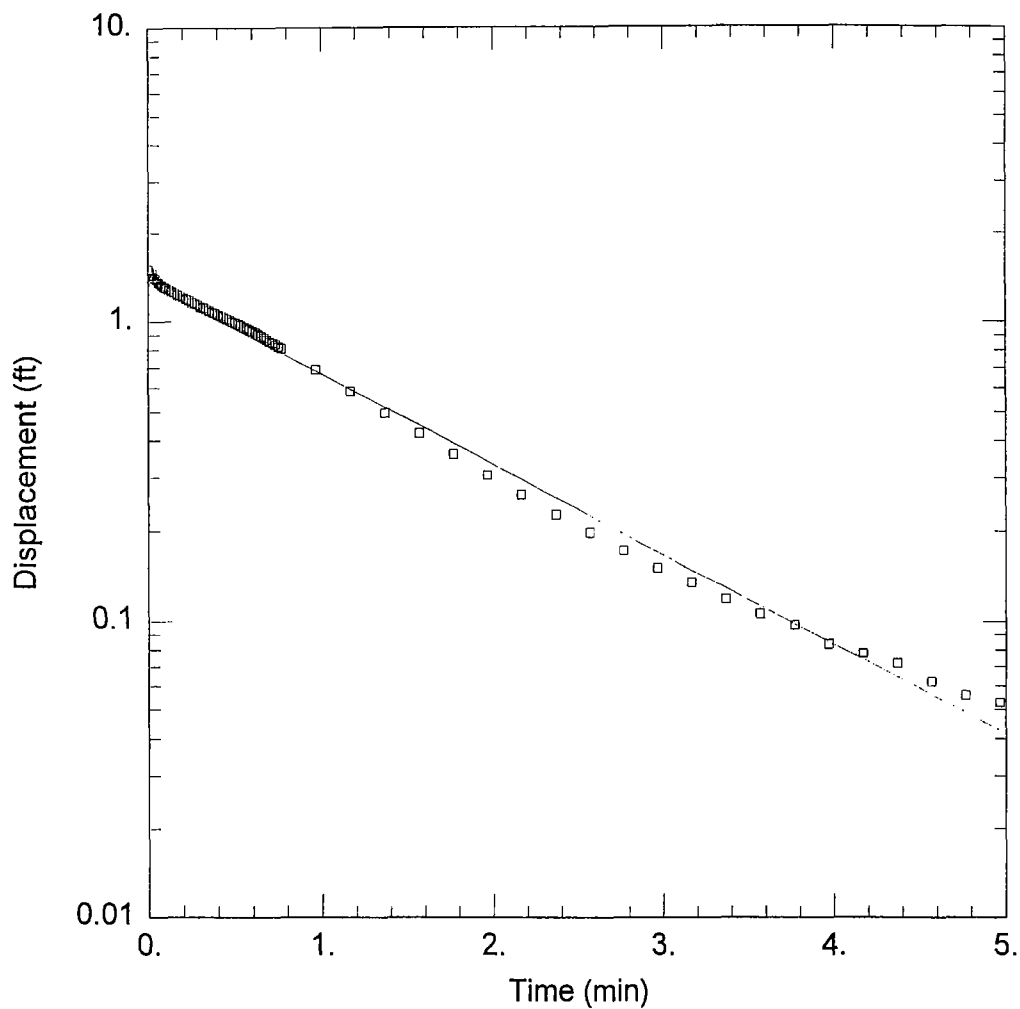
SOLUTION

Aquifer Model: Confined

$K = 1.516E-05$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.723$ ft



RFI-MW04, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\RFI04I.AQT

Date: 02/12/00

Time: 14:08:52

AQUIFER DATA

Saturated Thickness: 6.71 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1.5 ft

Water Column Height: 6.71 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

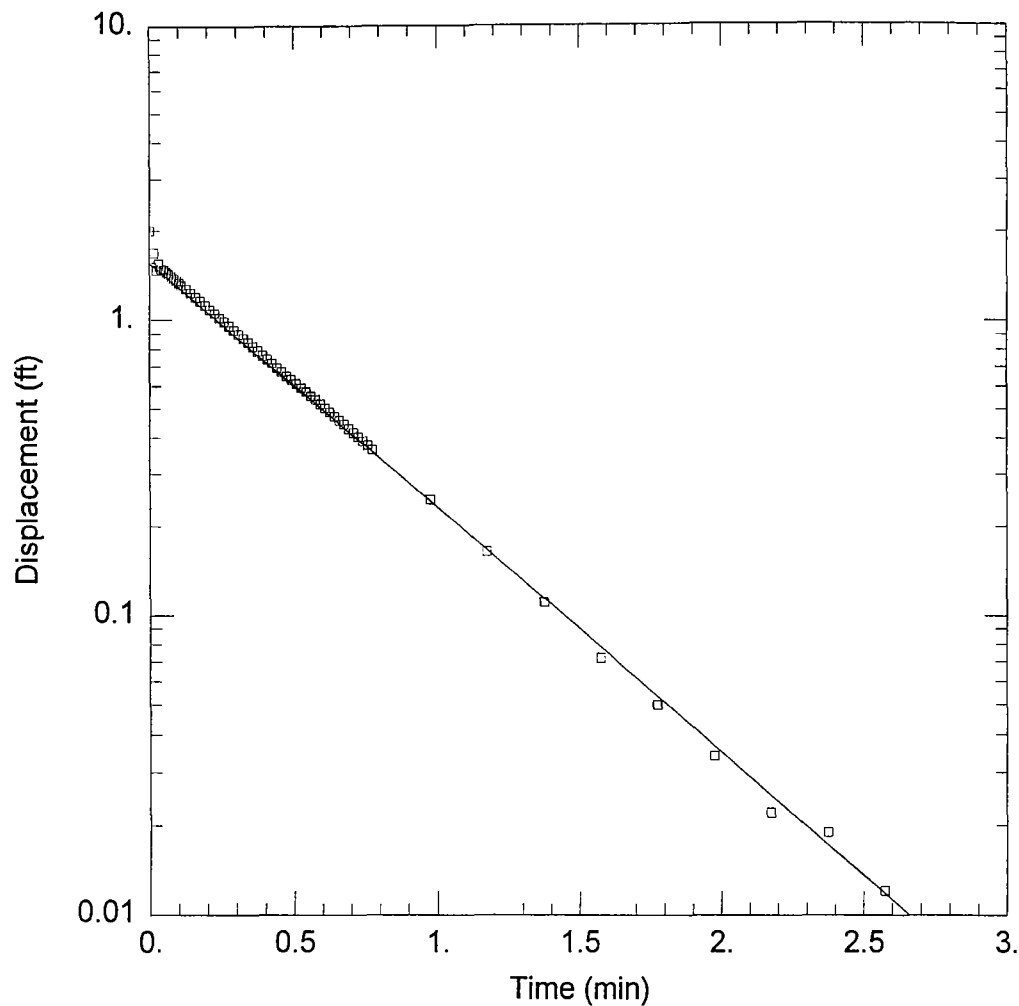
SOLUTION

Aquifer Model: Unconfined

$K = 0.001111$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.334$ ft



RFI-MW05, BASF, 08/99

Data Set: E:\PROJECT\A-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FRFI05I.AQT

Date: 02/12/00

Time: 14:09:02

AQUIFER DATA

Saturated Thickness: 9.82 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 2. ft

Water Column Height: 9.82 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

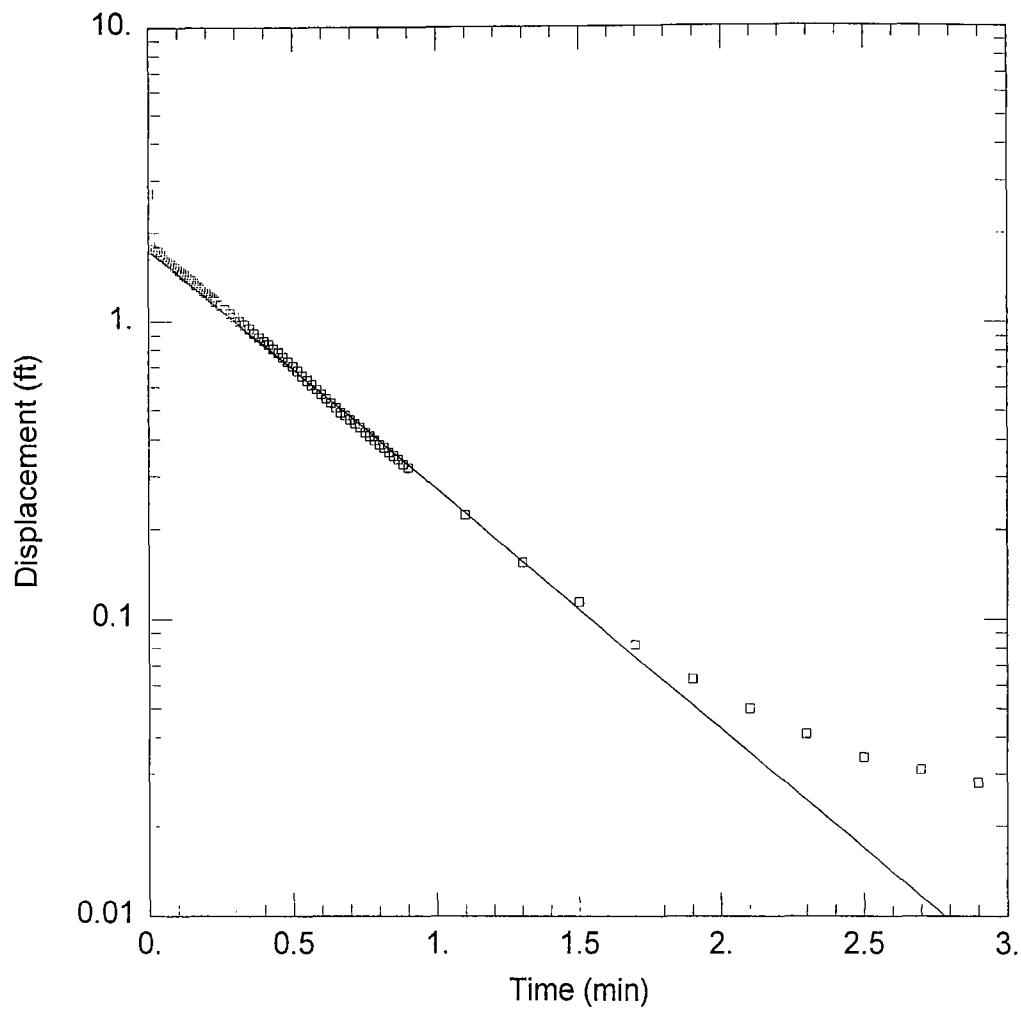
SOLUTION

Aquifer Model: Unconfined

$K = 0.003304$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.553$ ft



RFI-MW05, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\RFI05O.AQT

Date: 02/18/00

Time: 11:29:34

AQUIFER DATA

Saturated Thickness: 9.82 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 2.7 ft

Water Column Height: 9.82 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

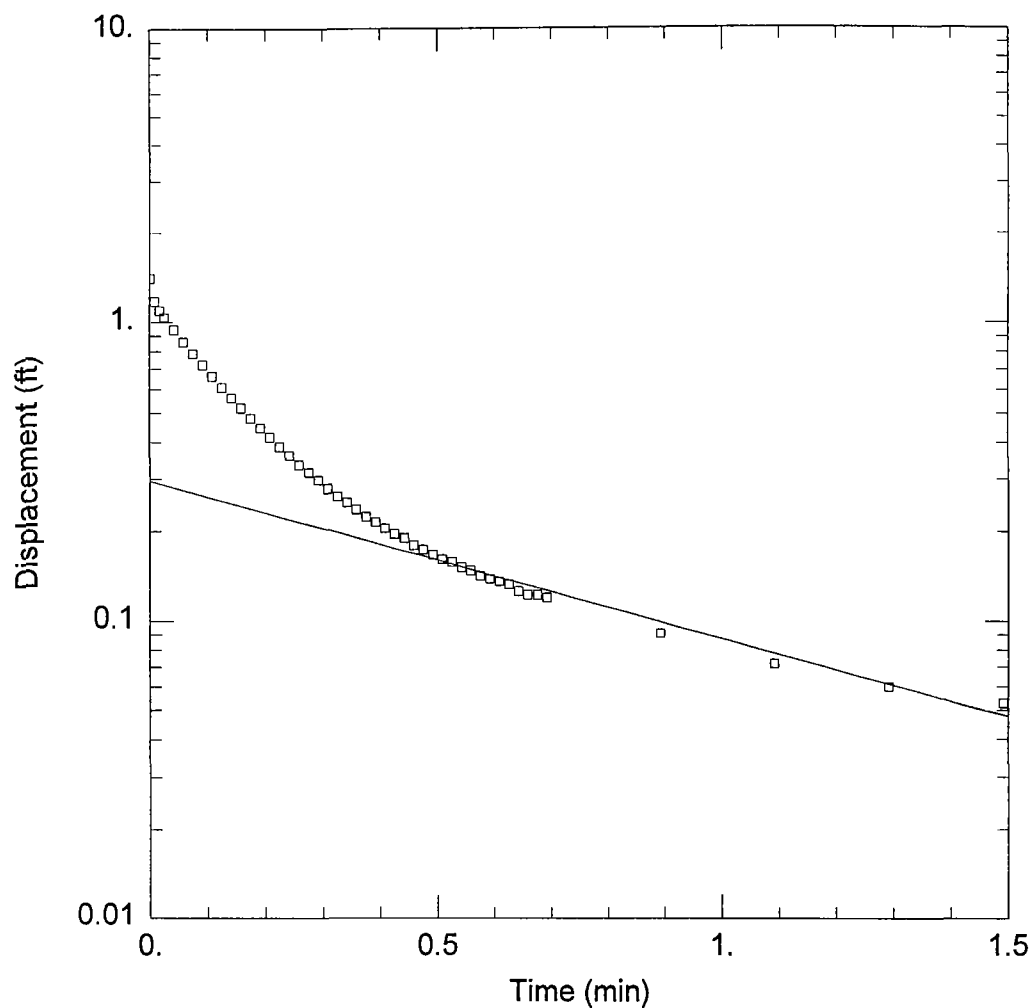
SOLUTION

Aquifer Model: Unconfined

$K = 0.006361$ ft/min

Solution Method: Bouwer-Rice

$y_0 = 1.741$ ft



BASF, 08/99

Data Set: E:\PROJECT\A-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FRFI06I.AQT

Date: 02/12/00

Time: 15:46:36

AQUIFER DATA

Saturated Thickness: 5.86 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1.4 ft

Water Column Height: 5.86 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

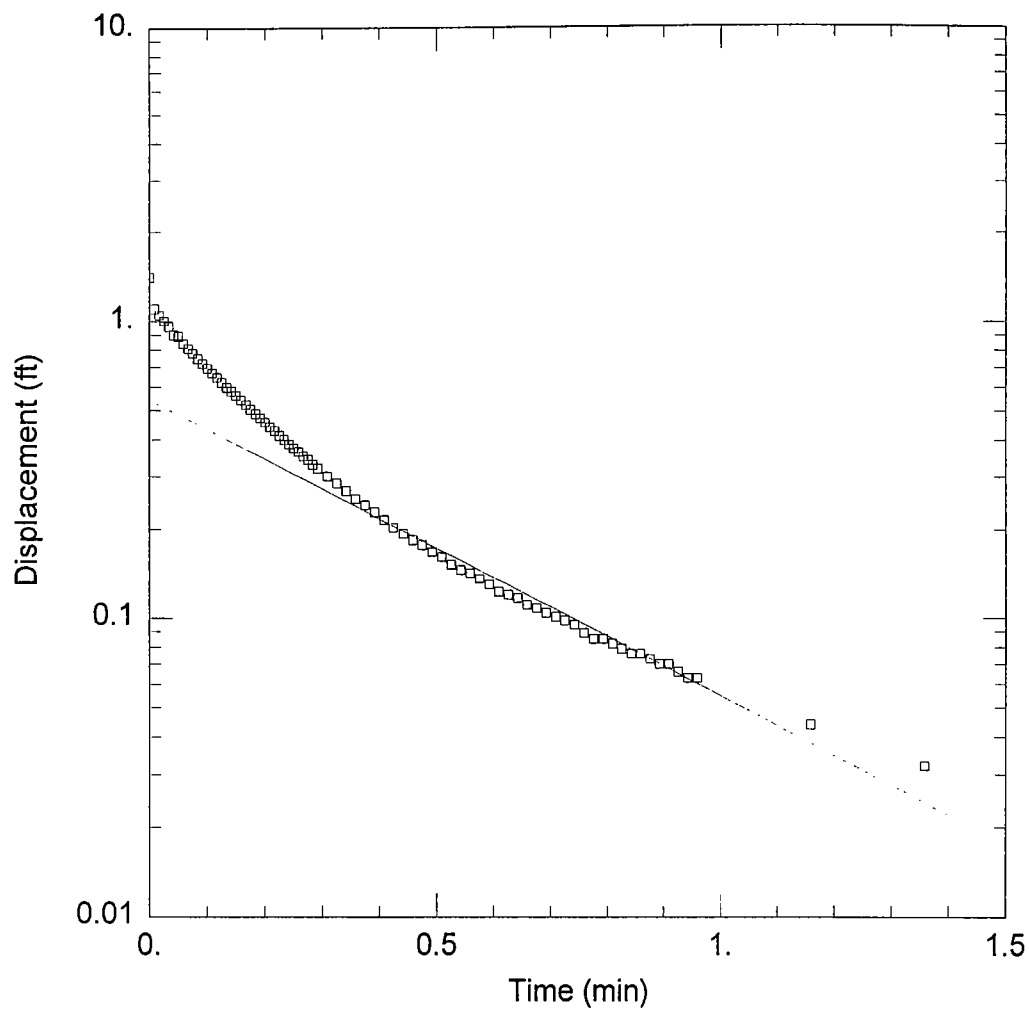
SOLUTION

Aquifer Model: Unconfined

$K = 0.001884$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.2941$ ft



RFI-MW06, BASF, 08/99

Data Set: E:\PROJECT\A-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FRFI06O.AQT
 Date: 02/12/00 Time: 14:09:17

AQUIFER DATA

Saturated Thickness: 5.86 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1.4 ft

Water Column Height: 5.86 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

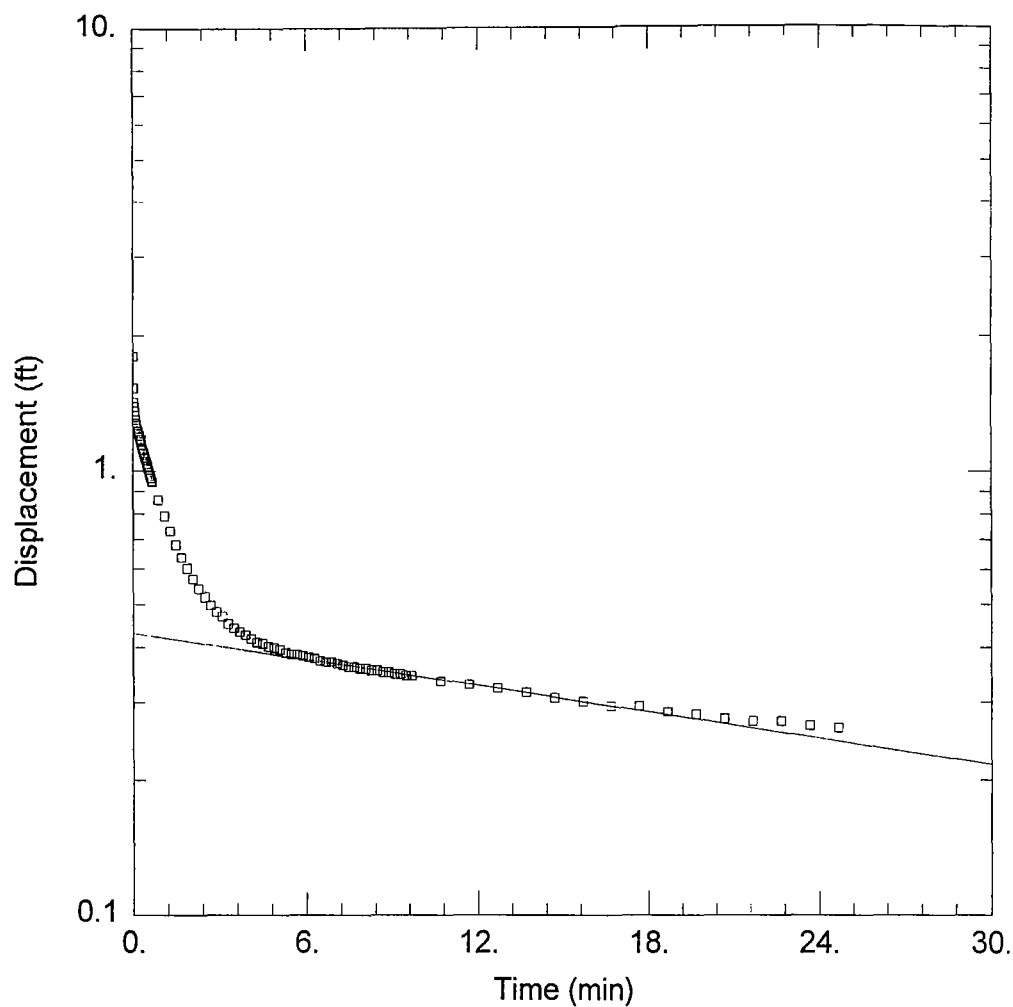
SOLUTION

Aquifer Model: Unconfined

$K = 0.003554$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.5431$ ft



RFI-MW07, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FRFI07I.AQT

Date: 02/12/00

Time: 14:09:47

AQUIFER DATA

Saturated Thickness: 7.5 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1.8 ft

Water Column Height: 6.42 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

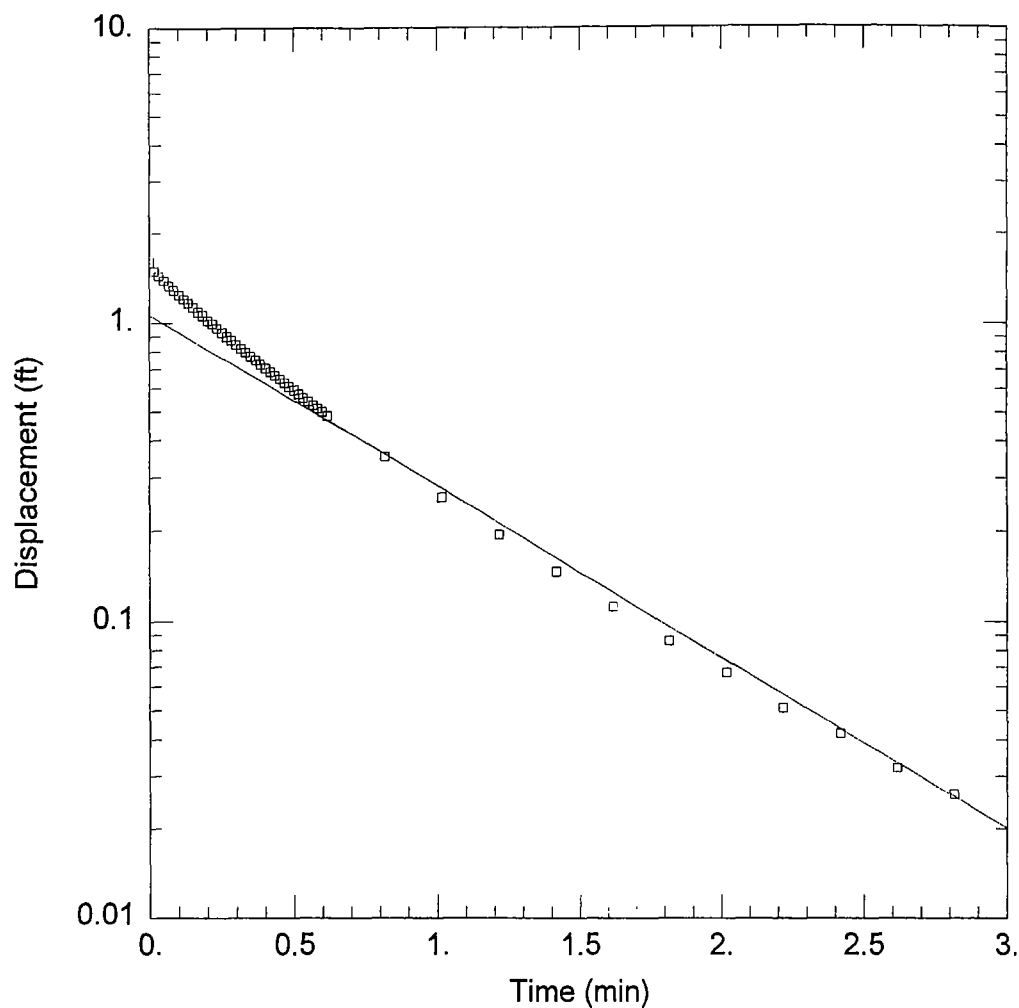
SOLUTION

Aquifer Model: Unconfined

$K = 2.656E-05$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.4305$ ft



BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FRFI08I.AQT

Date: 02/12/00

Time: 16:18:08

AQUIFER DATA

Saturated Thickness: 25. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1.6 ft

Water Column Height: 32.23 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

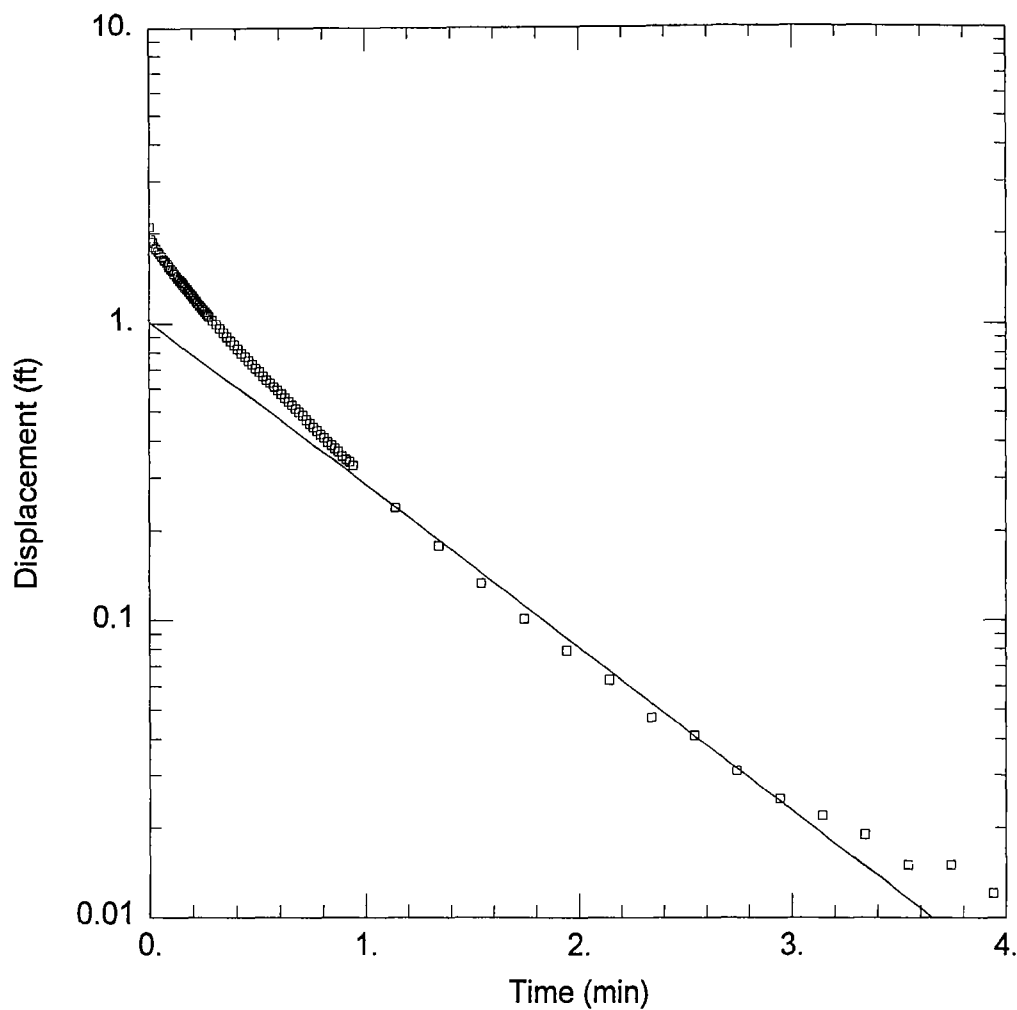
SOLUTION

Aquifer Model: Unconfined

$K = 0.002798$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.061$ ft



RFI-MW08, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FRFI08O.AQT

Date: 02/12/00

Time: 14:09:54

AQUIFER DATA

Saturated Thickness: 25. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 2.1 ft

Water Column Height: 32.23 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

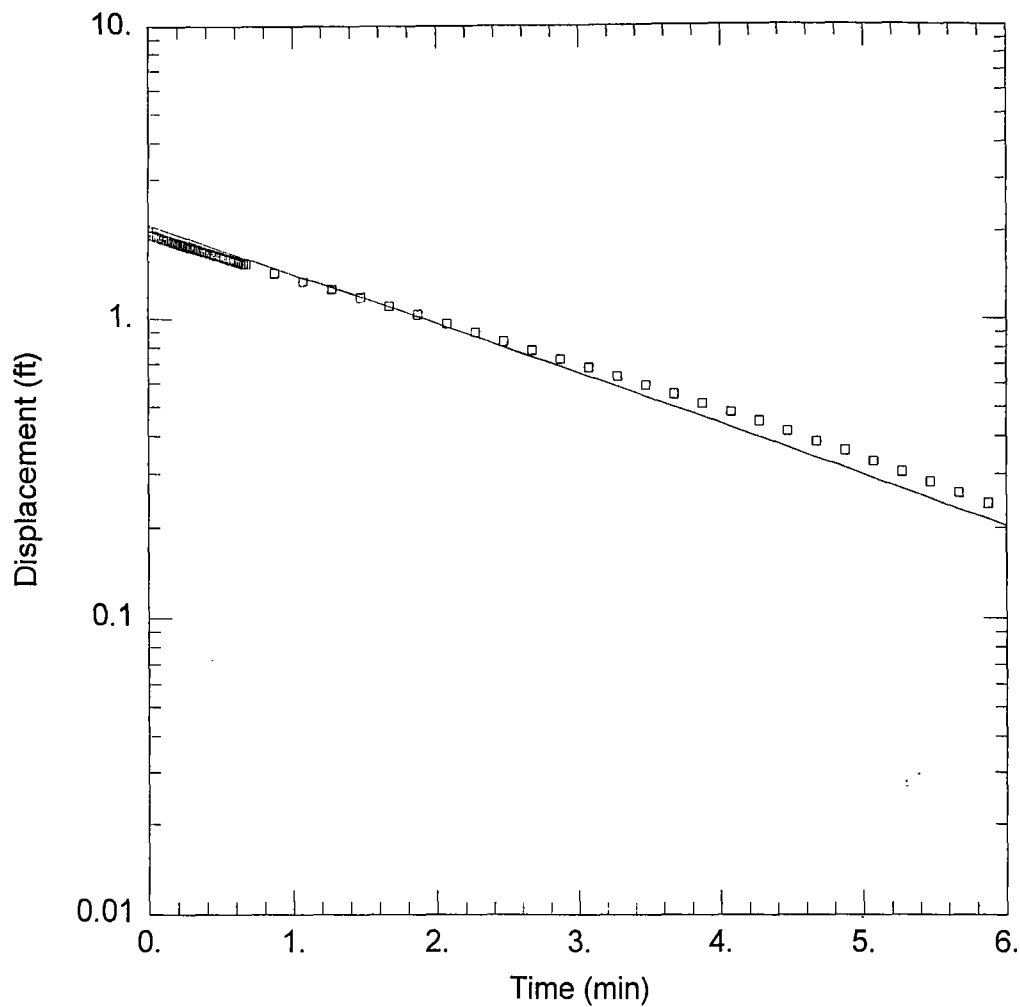
SOLUTION

Aquifer Model: Unconfined

$K = 0.002673$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.009$ ft



RFI-MW10, BASF, 08/99

Data Set: E:\PROJECT\A-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\RFI10I.AQT

Date: 02/12/00

Time: 14:12:12

AQUIFER DATA

Saturated Thickness: 35. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 2. ft

Water Column Height: 35.55 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

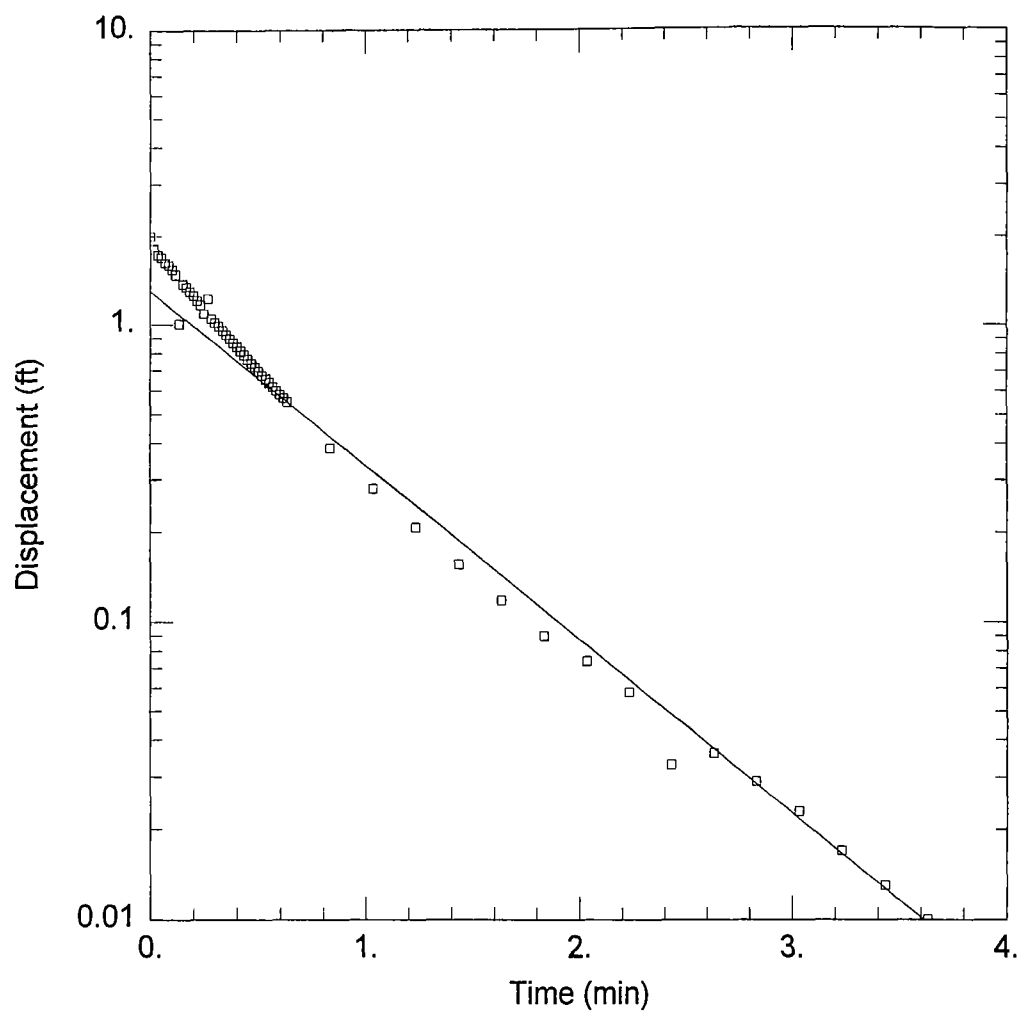
SOLUTION

Aquifer Model: Unconfined

$K = 0.0008357$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 2.103$ ft



BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FRF1131.AQT

Date: 02/12/00

Time: 15:53:35

AQUIFER DATA

Saturated Thickness: 14. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 2. ft

Water Column Height: 19.08 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

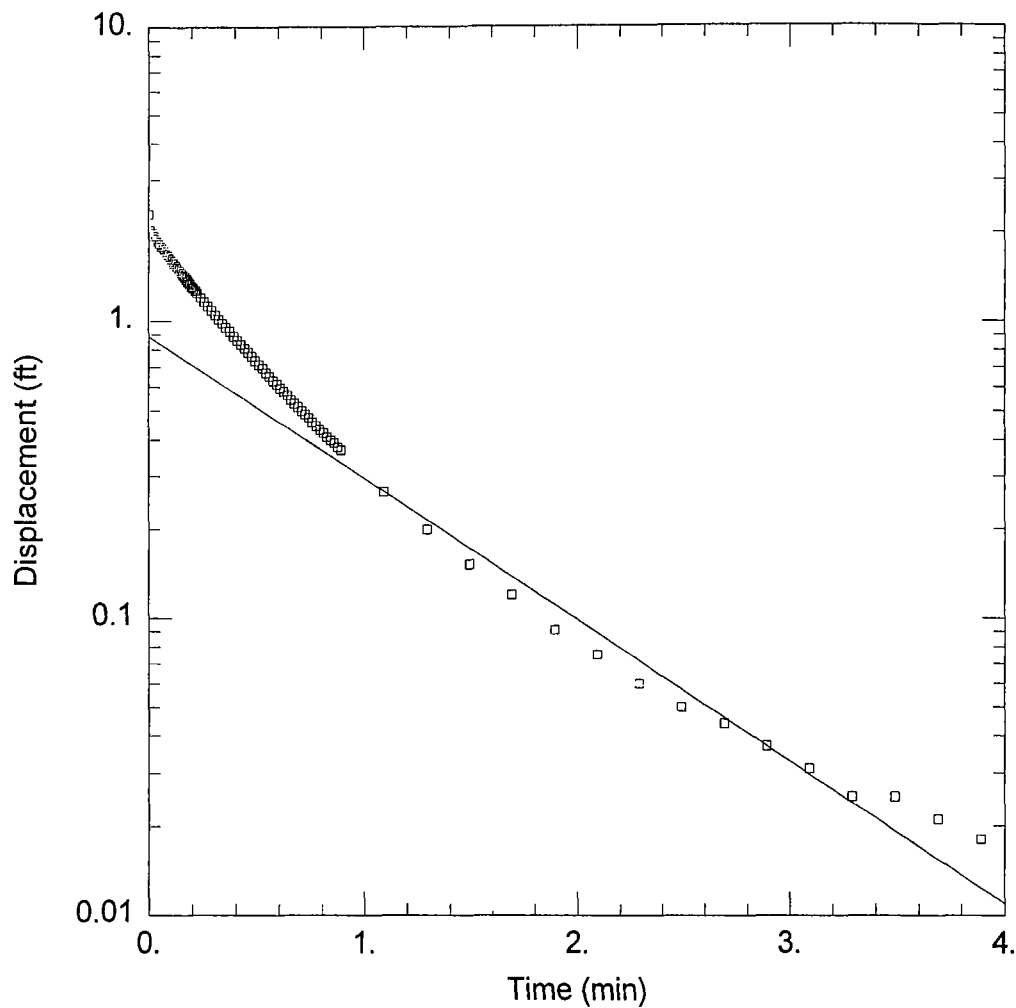
SOLUTION

Aquifer Model: Confined

$K = 0.002642$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.292$ ft



RFI-MW13, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\RFI130.AQT

Date: 02/12/00

Time: 14:12:21

AQUIFER DATA

Saturated Thickness: 14. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 2.3 ft

Water Column Height: 19.08 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

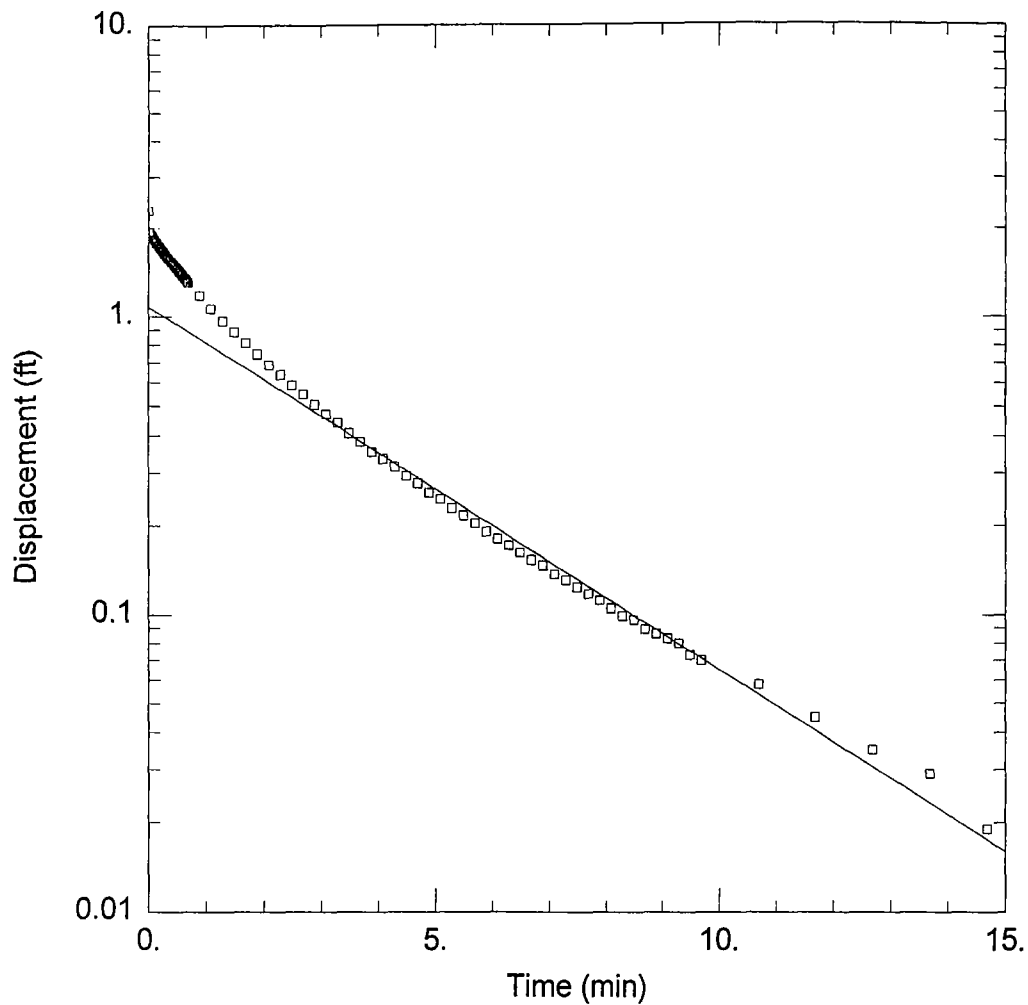
SOLUTION

Aquifer Model: Confined

$K = 0.002155$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.8861$ ft



RFI-MW14, BASF, 08/99

Data Set: E:\PROJECT\A-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FRFI14I.AQT

Date: 02/12/00

Time: 14:12:29

AQUIFER DATA

Saturated Thickness: 8 ft

Anisotropy Ratio (K_z/K_r): 1

WELL DATA

Initial Displacement: 2.3 ft

Water Column Height: 21.65 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2 ft

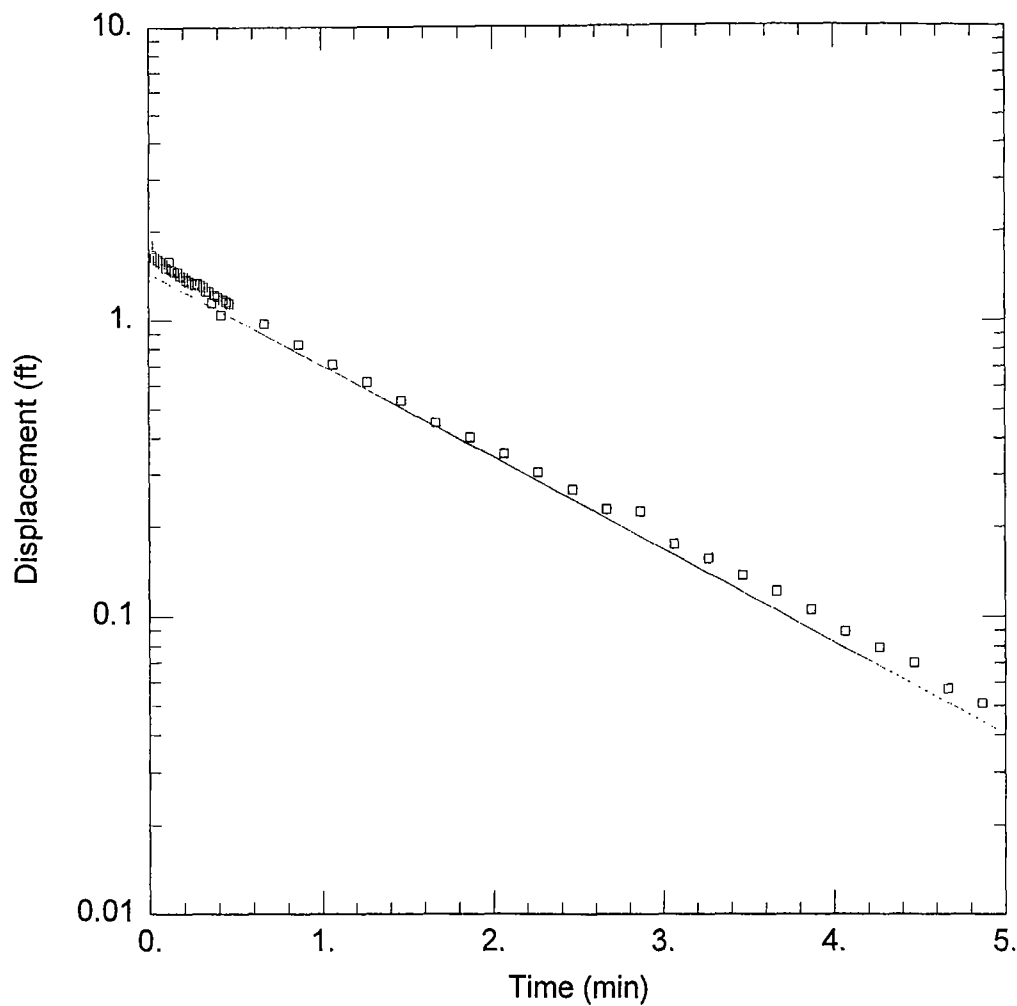
SOLUTION

Aquifer Model: Confined

$K = 0.0005613$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.076$ ft



RFI-MW22, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\RFI221.AQT

Date: 02/12/00

Time: 14:12:40

AQUIFER DATA

Saturated Thickness: 6. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1.8 ft

Water Column Height: 13.8 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

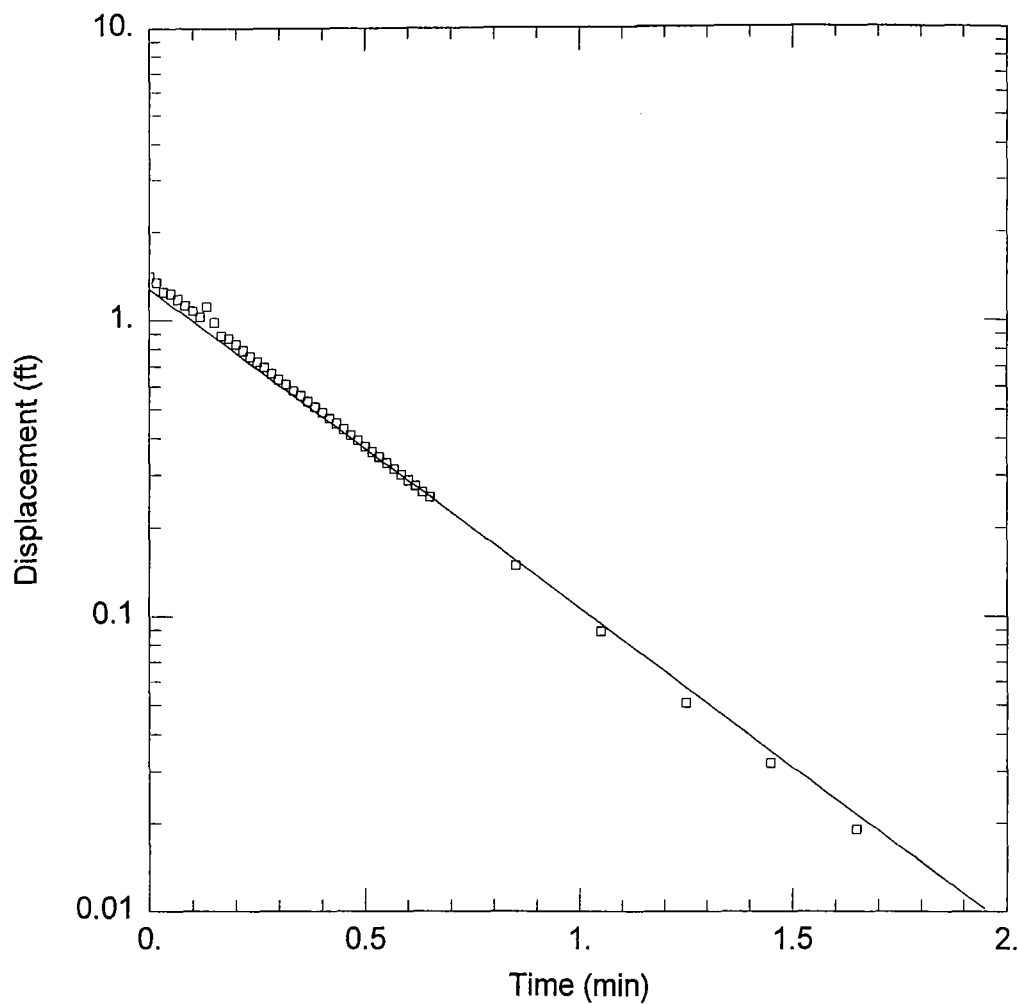
SOLUTION

Aquifer Model: Confined

$K = 0.00133$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.44$ ft



RFI-MW23, BASF, 08/99

Data Set: E:\PROJECT\A-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FRFI23\AQT
 Date: 02/12/00 Time: 14:12:57

AQUIFER DATA

Saturated Thickness: 4. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1.4 ft

Water Column Height: 7.36 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

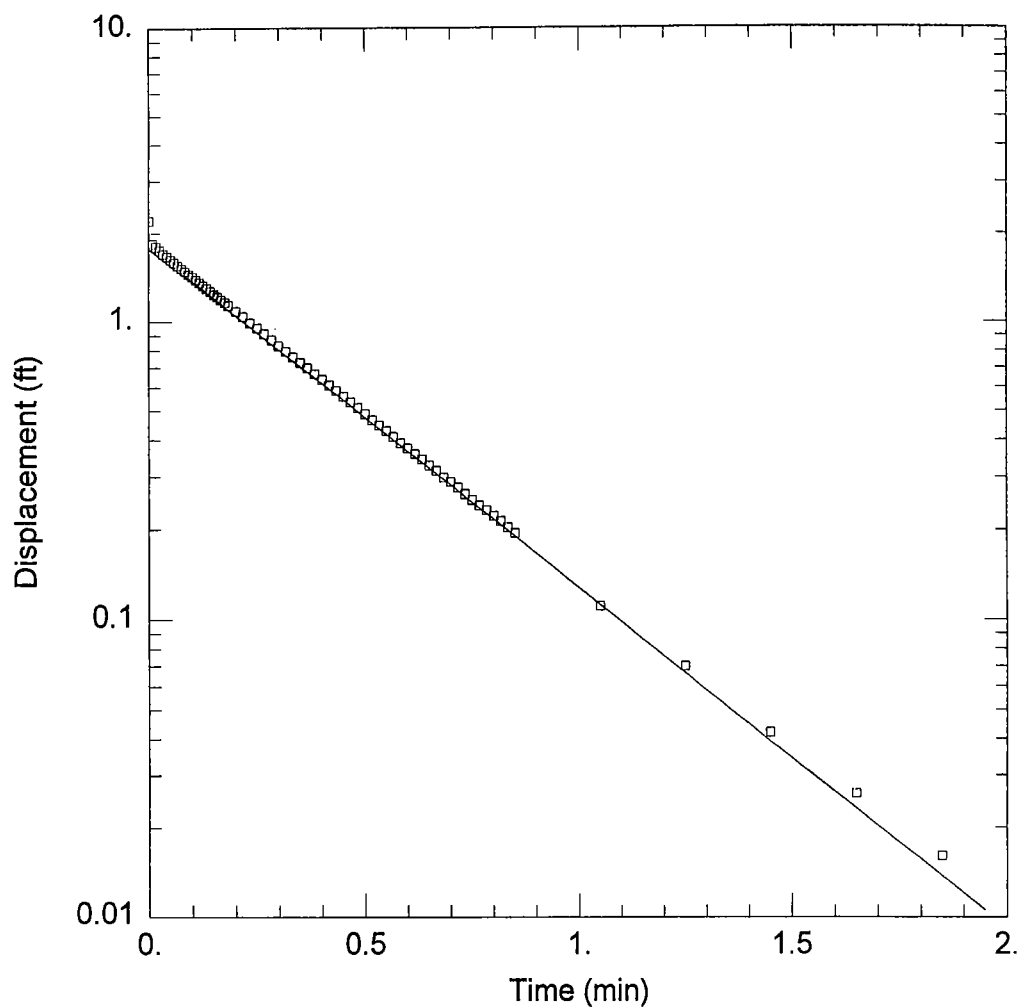
SOLUTION

Aquifer Model: Confined

$K = 0.004056$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.271$ ft



RFI-MW23, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\FRFI23O.AQT

Date: 02/12/00

Time: 14:13:06

AQUIFER DATA

Saturated Thickness: 4. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 2.2 ft

Water Column Height: 7.36 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

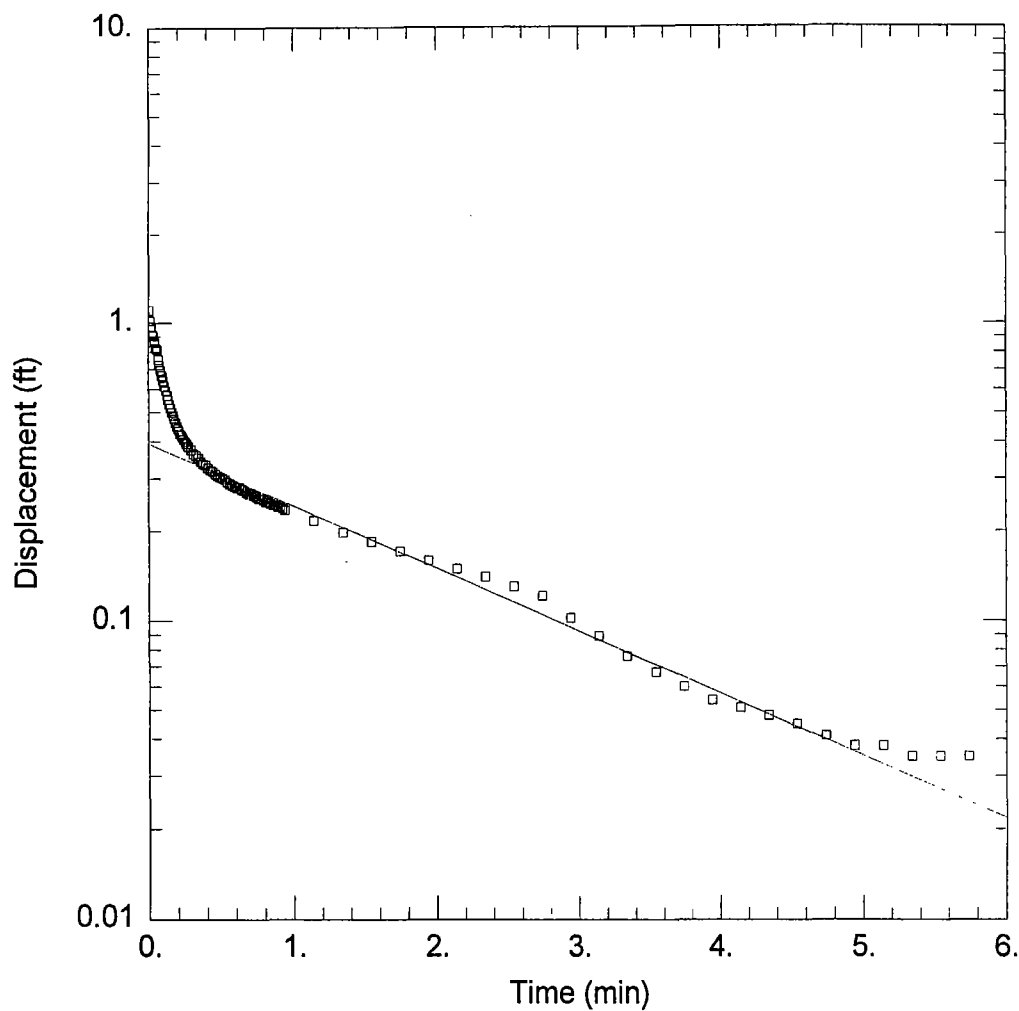
SOLUTION

Aquifer Model: Confined

$K = 0.004305$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 1.771$ ft



RFI-MW29, BASF, 08/99

Data Set: E:\PROJECTA-TO-F\BASF\CMSREP~1\SLUGTEST\FINAL~1\RFI29I.AQT

Date: 02/12/00

Time: 14:13:13

AQUIFER DATA

Saturated Thickness: 4.14 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 1.1 ft

Water Column Height: 4.14 ft

Casing Radius: 0.0833 ft

Wellbore Radius: 0.37 ft

Screen Length: 2. ft

SOLUTION

Aquifer Model: Unconfined

$K = 0.0006792$ cm/sec

Solution Method: Bouwer-Rice

$y_0 = 0.3922$ ft

**TABLE D.1
GROUNDWATER ANALYTICAL DATA RESULTS
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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-1 CMSMW-1 19-Aug-99 Water Field Sample A9H210120001 16-Sep-99	CMSMW-2 CMSMW-2 19-Aug-99 Water Field Sample A9H210120003 16-Sep-99	CMSMW-3 CMSMW-3 19-Aug-99 Water Field Sample A9H210120007 16-Sep-99	CMSMW-4 CMSMW-4 20-Aug-99 Water Field Sample A9H240148001 16-Sep-99	CMSMW-5 CMSMW-5 23-Aug-99 Water Field Sample A9H250128004 13-Sep-99	CMSMW-6 CMSMW-6 23-Aug-99 Water Field Sample A9H250128005 13-Sep-99	CMSMW-7 CMSMW-7 24-Aug-99 Water Field Sample A9H260105001 13-Sep-99
Analyte	Units							
VOCs								
1,1,1,2-Tetrachloroethane	ug/L	33 U	5 U	--	--	--	--	--
1,1,1-Trichloroethane	ug/L	33 U	5 U	--	--	--	--	--
1,1,2,2-Tetrachloroethane	ug/L	33 U	5 U	--	--	--	--	--
1,1,2-Trichloroethane	ug/L	33 U	5 U	--	--	--	--	--
1,1-Dichloroethane	ug/L	33 U	5 U	--	--	--	--	--
1,1-Dichloroethene	ug/L	33 U	5 U	--	--	--	--	--
1,2,3-Trichloropropane	ug/L	33 U	5 U	--	--	--	--	--
1,2-Dibromo-3-chloropropane	ug/L	670 U	100 U	--	--	--	--	--
1,2-Dibromoethane (EDB)	ug/L	33 U	5 U	--	--	--	--	--
1,2-Dichlorobenzene	ug/L	33 U	5 U	--	--	--	--	--
1,2-Dichloroethane	ug/L	33 U	5 U	--	--	--	--	--
1,2-Dichloropropane	ug/L	33 U	5 U	--	--	--	--	--
1,3-Dichlorobenzene	ug/L	33 U	5 U	--	--	--	--	--
1,4-Dichlorobenzene	ug/L	33 U	5 U	--	--	--	--	--
2-Hexanone	ug/L	330 U	50 U	--	--	--	--	--
4-Methyl-2-pentanone (MIBK)	ug/L	330 U	50 U	--	--	--	--	--
Acetone	ug/L	940 J	27 J	--	--	--	--	--
Acetonitrile	ug/L	3300 UR	500 U	--	--	--	--	--
Acrolein	ug/L	330 UR	50 UR	--	--	--	--	--
Acrylonitrile	ug/L	330 U	50 UR	--	--	--	--	--
Benzene	ug/L	33 U	5 U*	--	--	--	--	--
Bromodichloromethane	ug/L	33 U	5 U	--	--	--	--	--
Bromoform	ug/L	33 U	5 U	--	--	--	--	--
Bromomethane	ug/L	33 U	5 U	--	--	--	--	--
Carbon disulfide	ug/L	33 U	5 U	--	--	--	--	--
Carbon tetrachloride	ug/L	33 U	5 U	--	--	--	--	--
Chlorobenzene	ug/L	33 U	5 U	--	--	--	--	--
Chlorodibromomethane	ug/L	33 U	5 U	--	--	--	--	--
Chloroethane	ug/L	33 U	5 U	--	--	--	--	--
Chloroform	ug/L	33 U	5 U	--	--	--	--	--
Chloromethane	ug/L	33 U	5 U	--	--	--	--	--
cis-1,2-Dichloroethene	ug/L	33 U	5 U	--	--	--	--	--
cis-1,3-Dichloropropene	ug/L	33 U	5 U	--	--	--	--	--
Dibromomethane	ug/L	33 U	5 U	--	--	--	--	--
Dichlorodifluoromethane	ug/L	67 U	10 U	--	--	--	--	--
Ethyl methacrylate	ug/L	33 U	5 U	--	--	--	--	--

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-1 CMSMW-1 19-Aug-99 Water Field Sample A9H210120001 16-Sep-99	CMSMW-2 CMSMW-2 19-Aug-99 Water Field Sample A9H210120003 16-Sep-99	CMSMW-3 CMSMW-3 19-Aug-99 Water Field Sample A9H210120007 16-Sep-99	CMSMW-4 CMSMW-4 20-Aug-99 Water Field Sample A9H240148001 16-Sep-99	CMSMW-5 CMSMW-5 23-Aug-99 Water Field Sample A9H250128004 13-Sep-99	CMSMW-6 CMSMW-6 23-Aug-99 Water Field Sample A9H250128005 13-Sep-99	CMSMW-7 CMSMW-7 24-Aug-99 Water Field Sample A9H260105001 13-Sep-99
Analyte	Units							
Ethylbenzene	ug/L	33 U	5 U	--	--	--	--	--
Iodomethane	ug/L	330 U	50 U	--	--	--	--	--
Isobutyl alcohol	ug/L	17000 UR	2500 UR	--	--	--	--	--
Methacrylonitrile	ug/L	670 UJ	100 UJ	--	--	--	--	--
Methyl ethyl ketone	ug/L	330 U	50 U	--	--	--	--	--
Methyl methacrylate	ug/L	33 UJ	5 UJ	--	--	--	--	--
Methylene chloride	ug/L	33 U*	5 U*	--	--	--	--	--
m-Xylene & p-Xylene	ug/L	33 U	5 U	--	--	--	--	--
o-Xylene	ug/L	33 U	5 U	--	--	--	--	--
Propionitrile	ug/L	3300 UR	500 UR	--	--	--	--	--
Styrene	ug/L	33 U	5 U	--	--	--	--	--
Tetrachloroethene	ug/L	33 U	5 U	--	--	--	--	--
Toluene	ug/L	33 U	5 U	--	--	--	--	--
trans-1,3-Dichloropropene	ug/L	33 U	5 U	--	--	--	--	--
trans-1,4-Dichloro-2-butene	ug/L	33 U	5 U	--	--	--	--	--
Trichloroethene	ug/L	33 U	5 U	--	--	--	--	--
Trichlorofluoromethane	ug/L	33 U	5 U	--	--	--	--	--
Vinyl acetate	ug/L	330 U	50 U	--	--	--	--	--
Vinyl chloride	ug/L	33 U	5 U	--	--	--	--	--

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VOLATILE ORGANIC COMPOUNDS

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Analyte	Units							
VOCs								
1,1,1,2-Tetrachloroethane	ug/L	--	--	--	--	12 U	5 U	25 U
1,1,1-Trichloroethane	ug/L	--	--	--	--	12 U	5 U	25 U
1,1,2,2-Tetrachloroethane	ug/L	--	--	--	--	12 U	5 U	25 U
1,1,2-Trichloroethane	ug/L	--	--	--	--	12 U	5 U	25 U
1,1-Dichloroethane	ug/L	--	--	--	--	12 U	5 U	25 U
1,1-Dichloroethene	ug/L	--	--	--	--	12 U	5 U	25 U
1,2,3-Trichloropropane	ug/L	--	--	--	--	12 U	5 U	25 U
1,2-Dibromo-3-chloropropane	ug/L	--	--	--	--	250 UJ	100 UJ	500 UJ
1,2-Dibromoethane (EDB)	ug/L	--	--	--	--	12 U	5 U	25 U
1,2-Dichlorobenzene	ug/L	--	--	--	--	12 U	5 U	25 U
1,2-Dichloroethane	ug/L	--	--	--	--	12 U	5 UJ	25 UJ
1,2-Dichloropropane	ug/L	--	--	--	--	12 U	5 U	25 U
1,3-Dichlorobenzene	ug/L	--	--	--	--	12 U	5 U	25 U
1,4-Dichlorobenzene	ug/L	--	--	--	--	12 U	5 U	25 U
2-Hexanone	ug/L	--	--	--	--	120 U	50 U	250 U
4-Methyl-2-pentanone (MIBK)	ug/L	--	--	--	--	120 U	50 U	250 U
Acetone	ug/L	--	--	--	--	120 UR	83 J	250 UR
Acetonitrile	ug/L	--	--	--	--	1200 UR	500 UR	2500 UR
Acrolein	ug/L	--	--	--	--	120 UR	50 UR	250 UR
Acrylonitrile	ug/L	--	--	--	--	120 UR	50 UR	250 UR
Benzene	ug/L	--	--	--	--	12 U*	66	25 U*
Bromodichloromethane	ug/L	--	--	--	--	12 U	5 U	25 U*
Bromoform	ug/L	--	--	--	--	12 UJ	5 U	25 U
Bromomethane	ug/L	--	--	--	--	12 UJ	5 U	25 U
Carbon disulfide	ug/L	--	--	--	--	1.5 J	5 U	25 U
Carbon tetrachloride	ug/L	--	--	--	--	12 U	5 U	25 U
Chlorobenzene	ug/L	--	--	--	--	12 U	5 U	25 U
Chlorodibromomethane	ug/L	--	--	--	--	12 U	5 U	25 U
Chloroethane	ug/L	--	--	--	--	12 U	5 U	25 U
Chloroform	ug/L	--	--	--	--	12 U	5 U	25 U
Chloromethane	ug/L	--	--	--	--	12 U	5 U	25 U
cis-1,2-Dichloroethene	ug/L	--	--	--	--	12 U	5 U	25 U
cis-1,3-Dichloropropene	ug/L	--	--	--	--	12 U	5 U	25 U
Dibromomethane	ug/L	--	--	--	--	12 U	5 U	25 U
Dichlorodifluoromethane	ug/L	--	--	--	--	25 U	10 U	50 U
Ethyl methacrylate	ug/L	--	--	--	--	12 U	5 U	25 U

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Analyte	Units							
Ethylbenzene	ug/L	--	--	--	--	12 U	5 U	25 U
Iodomethane	ug/L	--	--	--	--	120 UJ	50 UJ	250 UJ
Isobutyl alcohol	ug/L	--	--	--	--	6200 UR	2500 UR	12000 UR
Methacrylonitrile	ug/L	--	--	--	--	250 U	100 U	500 U
Methyl ethyl ketone	ug/L	--	--	--	--	120 UR	50 UR	250 UR
Methyl methacrylate	ug/L	--	--	--	--	12 U	5 U	25 U
Methylene chloride	ug/L	--	--	--	--	14 U*	7.6 U*	39 U*
m-Xylene & p-Xylene	ug/L	--	--	--	--	12 U	5 U	25 U
o-Xylene	ug/L	--	--	--	--	12 U	0.68 J	25 U
Propionitrile	ug/L	--	--	--	--	1200 UR	500 UR	2500 UR
Styrene	ug/L	--	--	--	--	12 U	5 U	25 U
Tetrachloroethene	ug/L	--	--	--	--	12 U	5 U	25 U
Toluene	ug/L	--	--	--	--	12 U	5 U*	25 U
trans-1,3-Dichloropropene	ug/L	--	--	--	--	12 U	5 U	25 U
trans-1,4-Dichloro-2-butene	ug/L	--	--	--	--	12 U	5 U	25 U
Trichloroethene	ug/L	--	--	--	--	12 U	5 U	25 U
Trichlorofluoromethane	ug/L	--	--	--	--	12 U	5 U	25 U
Vinyl acetate	ug/L	--	--	--	--	120 UJ	50 U	250 U
Vinyl chloride	ug/L	--	--	--	--	12 U	5 U	25 U

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-14S CMSMW-14S 25-Aug-99 Water Field Sample A9H270119002 13-Sep-99	CMSMW-39S CMSMW-39S 25-Aug-99 Water Field Sample A9H270119003 13-Sep-99	CMSMW-15 CMSMW-15 19-Aug-99 Water Field Sample A9H210120005 16-Sep-99	CMSMW-16F CMSMW-16F 24-Aug-99 Water Field Sample A9H260105007 13-Sep-99	CMSMW-18 CMSMW-18 24-Aug-99 Water Field Sample A9H260105004 13-Sep-99	RFIMW-1 RFIMW-1 19-Aug-99 Water Field Sample A9H210120006 16-Sep-99	RFIMW-4 RFIMW-4 20-Aug-99 Water Field Sample A9H240148004 16-Sep-99
Analyte	Units							
VOCs								
1,1,1,2-Tetrachloroethane	ug/L	5 U	5 U	5 U	--	--	20 U	--
1,1,1-Trichloroethane	ug/L	5 U	5 U	5 U	--	--	20 U	--
1,1,2-Tetrachloroethane	ug/L	5 U	5 U	5 U	--	--	20 U	--
1,1,2-Trichloroethane	ug/L	5 U	5 U	5 U	--	--	20 U	--
1,1-Dichloroethane	ug/L	5 U	5 U	5 U	--	--	20 U	--
1,1-Dichloroethene	ug/L	5 U	5 U	5 U	--	--	20 U	--
1,2,3-Trichloropropane	ug/L	5 U	5 U	5 U	--	--	20 U	--
1,2-Dibromo-3-chloropropane	ug/L	100 UJ	100 UJ	100 U	--	--	400 UJ	--
1,2-Dibromoethane (EDB)	ug/L	5 U	5 U	5 U	--	--	20 U	--
1,2-Dichlorobenzene	ug/L	5 U	5 U	5 U	--	--	20 U	--
1,2-Dichloroethane	ug/L	5 U	5 U	5 U	--	--	20 UJ	--
1,2-Dichloropropane	ug/L	0.48 J	0.56 J	5 U	--	--	20 U	--
1,3-Dichlorobenzene	ug/L	5 U	5 U	5 U	--	--	20 U	--
1,4-Dichlorobenzene	ug/L	5 U	5 U	5 U	--	--	20 U	--
2-Hexanone	ug/L	50 U	50 U	50 U	--	--	200 U	--
4-Methyl-2-pentanone (MIBK)	ug/L	50 U	50 UR	50 U	--	--	200 U	--
Acetone	ug/L	420 J	510 J	50 U	--	--	240 J	--
Acetonitrile	ug/L	500 UR	500 UR	500 UR	--	--	2000 UR	--
Acrolein	ug/L	50 UR	50 UR	50 UR	--	--	200 UR	--
Acrylonitrile	ug/L	50 UR	50 UR	50 U	--	--	200 UR	--
Benzene	ug/L	5 U*	5 U*	5 U*	--	--	120	--
Bromodichloromethane	ug/L	5 U	5 U	5 U	--	--	20 U	--
Bromoform	ug/L	5 UJ	5 UJ	5 U	--	--	20 U	--
Bromomethane	ug/L	5 UJ	5 UJ	5 U	--	--	2.7 J	--
Carbon disulfide	ug/L	5 U	5 U	5 U	--	--	20 U	--
Carbon tetrachloride	ug/L	5 U	5 U	5 U	--	--	20 U	--
Chlorobenzene	ug/L	5 U	5 U	5 U	--	--	20 U*	--
Chlorodibromomethane	ug/L	5 U	5 U	5 U	--	--	20 U	--
Chloroethane	ug/L	5 U	5 U	5 U	--	--	20 U	--
Chloroform	ug/L	5 U	5 U	5 U	--	--	20 U	--
Chloromethane	ug/L	5 U	5 U	5 U	--	--	20 U	--
cis-1,2-Dichloroethene	ug/L	5 U	5 U	5 U	--	--	20 U	--
cis-1,3-Dichloropropene	ug/L	5 U	5 U	5 U	--	--	20 U	--
Dibromomethane	ug/L	5 U	5 U	5 U	--	--	20 U	--
Dichlorodifluoromethane	ug/L	10 U	10 U	10 U	--	--	40 U	--
Ethyl methacrylate	ug/L	5 U	5 U	5 U	--	--	20 U	--

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Analyte	Units							
Ethylbenzene	ug/L	5 U	5 U	2.8 J —	—	—	20 U	—
Iodomethane	ug/L	50 UJ	50 UJ	50 U	—	—	200 UJ	—
Isobutyl alcohol	ug/L	2500 UR	2500 UR	2500 UR	—	—	10000 UR	—
Methacrylonitrile	ug/L	100 U	100 U	100 UJ	—	—	400 U	—
Methyl ethyl ketone	ug/L	50 UR	50 U	50 U	—	—	200 UR	—
Methyl methacrylate	ug/L	5 U	5 U	5 UJ	—	—	20 U	—
Methylene chloride	ug/L	5 U*	5 U*	5 U*	—	—	20 U*	—
m-Xylene & p-Xylene	ug/L	5 U	5 U	5 U	—	—	20 U	—
o-Xylene	ug/L	5 U	5 U	5 U	—	—	20 U	—
Propionitrile	ug/L	500 UR	500 UR	500 UR	—	—	2000 UR	—
Styrene	ug/L	5 U	5 U	3.6 J —	—	—	20 U	—
Tetrachloroethene	ug/L	5 U	5 U	5 U	—	—	20 U	—
Toluene	ug/L	5 U	5 U	5 U*	—	—	20 U*	—
trans-1,3-Dichloropropene	ug/L	5 U	5 U	5 U	—	—	20 U	—
trans-1,4-Dichloro-2-butene	ug/L	5 U	5 U	5 U	—	—	20 U	—
Trichloroethene	ug/L	5 U	5 U	5 U	—	—	20 U	—
Trichlorofluoromethane	ug/L	5 U	5 U	5 U	—	—	20 U	—
Vinyl acetate	ug/L	50 UJ	50 UJ	50 U	—	—	200 U	—
Vinyl chloride	ug/L	5 U	5 U	5 U	—	—	9.4 J	—

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Analyte	Units							
VOCs								
1,1,1,2-Tetrachloroethane	ug/L	--	--	--	--	--	--	--
1,1,1-Trichloroethane	ug/L	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	ug/L	--	--	--	--	--	--	--
1,1,2-Trichloroethane	ug/L	--	--	--	--	--	--	--
1,1-Dichloroethane	ug/L	--	--	--	--	--	--	--
1,1-Dichloroethene	ug/L	--	--	--	--	--	--	--
1,2,3-Trichloropropane	ug/L	--	--	--	--	--	--	--
1,2-Dibromo-3-chloropropane	ug/L	--	--	--	--	--	--	--
1,2-Dibromoethane (EDB)	ug/L	--	--	--	--	--	--	--
1,2-Dichlorobenzene	ug/L	--	--	--	--	--	--	--
1,2-Dichloroethane	ug/L	--	--	--	--	--	--	--
1,2-Dichloropropane	ug/L	--	--	--	--	--	--	--
1,3-Dichlorobenzene	ug/L	--	--	--	--	--	--	--
1,4-Dichlorobenzene	ug/L	--	--	--	--	--	--	--
2-Hexanone	ug/L	--	--	--	--	--	--	--
4-Methyl-2-pentanone (MIBK)	ug/L	--	--	--	--	--	--	--
Acetone	ug/L	--	--	--	--	--	--	--
Acetonitrile	ug/L	--	--	--	--	--	--	--
Acrolein	ug/L	--	--	--	--	--	--	--
Acrylonitrile	ug/L	--	--	--	--	--	--	--
Benzene	ug/L	--	--	--	--	--	--	--
Bromodichloromethane	ug/L	--	--	--	--	--	--	--
Bromoform	ug/L	--	--	--	--	--	--	--
Bromomethane	ug/L	--	--	--	--	--	--	--
Carbon disulfide	ug/L	--	--	--	--	--	--	--
Carbon tetrachloride	ug/L	--	--	--	--	--	--	--
Chlorobenzene	ug/L	--	--	--	--	--	--	--
Chlorodibromomethane	ug/L	--	--	--	--	--	--	--
Chloroethane	ug/L	--	--	--	--	--	--	--
Chloroform	ug/L	--	--	--	--	--	--	--
Chloromethane	ug/L	--	--	--	--	--	--	--
cis-1,2-Dichloroethene	ug/L	--	--	--	--	--	--	--
cis-1,3-Dichloropropene	ug/L	--	--	--	--	--	--	--
Dibromomethane	ug/L	--	--	--	--	--	--	--
Dichlorodifluoromethane	ug/L	--	--	--	--	--	--	--
Ethyl methacrylate	ug/L	--	--	--	--	--	--	--

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Analyte	Units							
Ethylbenzene	ug/L	--	--	--	--	--	--	--
Iodomethane	ug/L	--	--	--	--	--	--	--
Isobutyl alcohol	ug/L	--	--	--	--	--	--	--
Methacrylonitrile	ug/L	--	--	--	--	--	--	--
Methyl ethyl ketone	ug/L	--	--	--	--	--	--	--
Methyl methacrylate	ug/L	--	--	--	--	--	--	--
Methylene chloride	ug/L	--	--	--	--	--	--	--
m-Xylene & p-Xylene	ug/L	--	--	--	--	--	--	--
o-Xylene	ug/L	--	--	--	--	--	--	--
Propionitrile	ug/L	--	--	--	--	--	--	--
Styrene	ug/L	--	--	--	--	--	--	--
Tetrachloroethene	ug/L	--	--	--	--	--	--	--
Toluene	ug/L	--	--	--	--	--	--	--
trans-1,3-Dichloropropene	ug/L	--	--	--	--	--	--	--
trans-1,4-Dichloro-2-butene	ug/L	--	--	--	--	--	--	--
Trichloroethene	ug/L	--	--	--	--	--	--	--
Trichlorofluoromethane	ug/L	--	--	--	--	--	--	--
Vinyl acetate	ug/L	--	--	--	--	--	--	--
Vinyl chloride	ug/L	--	--	--	--	--	--	--

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Analyte	Units				
VOCs					
1,1,1,2-Tetrachloroethane	ug/L	100 UJ	1 U	1 U	25 U
1,1,1-Trichloroethane	ug/L	100 UJ	1 U	1 U	25 U
1,1,2,2-Tetrachloroethane	ug/L	100 UJ	1 U	1 U	25 U
1,1,2-Trichloroethane	ug/L	100 UJ	1 U	1 U	25 U
1,1-Dichloroethane	ug/L	100 UJ	1 U	1 U	25 U
1,1-Dichloroethene	ug/L	100 UJ	1 U	1 U	25 U
1,2,3-Trichloropropane	ug/L	100 UJ	1 U	1 U	25 U
1,2-Dibromo-3-chloropropane	ug/L	2000 UJ	20 U	20 UJ	500 UJ
1,2-Dibromoethane (EDB)	ug/L	100 UJ	1 U	1 U	25 U
1,2-Dichlorobenzene	ug/L	100 UJ	1 U	1 U	25 U
1,2-Dichloroethane	ug/L	100 UJ	1 U	1 UJ	25 UJ
1,2-Dichloropropane	ug/L	100 UJ	1 U	1 U	25 U
1,3-Dichlorobenzene	ug/L	100 UJ	1 U	1 U	25 U
1,4-Dichlorobenzene	ug/L	100 UJ	10 U	1 U	25 U
2-Hexanone	ug/L	1000 UJ	10 U	10 U	250 U
4-Methyl-2-pentanone (MIBK)	ug/L	1000 UJ	10 U	10 U	250 U
Acetone	ug/L	9000 J	10 U	10 UR	250 UR
Acetonitrile	ug/L	10000 UR	100 UR	100 UR	2500 UR
Acrolein	ug/L	1000 UR	10 UR	10 UR	250 UR
Acrylonitrile	ug/L	1000 UR	10 U	10 UR	250 UR
Benzene	ug/L	2600 J	1 U*	1 U	25 U
Bromodichloromethane	ug/L	100 UJ	1 U	1 U	25 U
Bromoform	ug/L	100 UJ	1 U	1 U	25 U
Bromomethane	ug/L	100 UJ	1 U	1 U	25 U
Carbon disulfide	ug/L	100 UJ	1 U	1 U	25 U
Carbon tetrachloride	ug/L	100 UJ	1 U	1 U	25 U
Chlorobenzene	ug/L	100 U*	1 U*	1 U	25 U
Chlorodibromomethane	ug/L	100 UJ	1 U	1 U	25 U
Chloroethane	ug/L	100 UJ	1 U	1 U	25 U
Chloroform	ug/L	100 UJ	1 U	1 U	25 U
Chloromethane	ug/L	100 UJ	1 U	1 U	25 U
cis-1,2-Dichloroethene	ug/L	100 UJ	1 U	1 U	25 U
cis-1,3-Dichloropropene	ug/L	100 UJ	1 U	1 U	25 U
Dibromomethane	ug/L	100 UJ	1 U	1 U	25 U
Dichlorodifluoromethane	ug/L	200 UJ	2 U	2 U	50 U
Ethyl methacrylate	ug/L	100 UJ	1 U	1 U	25 U

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Analyte	Units				
Ethylbenzene	ug/L	100 UJ	1 U	1 U	25 U
Iodomethane	ug/L	1000 UJ	10 U	10 UJ	250 UJ
Isobutyl alcohol	ug/L	50000 UR	500 UR	500 UR	12000 UR
Methacrylonitrile	ug/L	2000 UJ	20 UJ	20 U	500 U
Methyl ethyl ketone	ug/L	1000 UR	10 U	10 UR	250 UR
Methyl methacrylate	ug/L	100 UJ	1 UJ	1 U	25 U
Methylene chloride	ug/L	100 U*	1 U*	4.6 U*	30 U*
m-Xylene & p-Xylene	ug/L	100 UJ	1 U	1 U	25 U
o-Xylene	ug/L	100 UJ	1 U	1 U	25 U
Propionitrile	ug/L	10000 UR	100 UR	100 UR	2500 UR
Styrene	ug/L	100 UJ	1 U	1 U	25 U
Tetrachloroethene	ug/L	100 UJ	1 U	1 U	25 U
Toluene	ug/L	110 U*	1 U	1 U	25 U
trans-1,3-Dichloropropene	ug/L	100 UJ	1 U	1 U	25 U
trans-1,4-Dichloro-2-butene	ug/L	100 UJ	1 U	1 U	25 U
Trichloroethene	ug/L	100 UJ	1 U	1 U	25 U
Trichlorofluoromethane	ug/L	100 UJ	1 U	1 U	25 U
Vinyl acetate	ug/L	1000 UJ	10 U	10 U	250 U
Vinyl chloride	ug/L	370 J	1 U	1 U	25 U

TABLE D.2
GROUNDWATER ANALYTICAL DATA RESULTS
SEMIVOLATILE ORGANIC COMPOUNDS

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Analyte	Units							
SVOCs								
1,2,4,5-Tetrachlorobenzene	ug/L	5 U	5 U	--	--	--	--	--
1,2,4-Trichlorobenzene	ug/L	5 U	5 U	--	--	--	--	--
1,3,5-Trinitrobenzene	ug/L	50 UJ	50 U	--	--	--	--	--
1,3-Dinitrobenzene	ug/L	10 U	10 U	--	--	--	--	--
1,4-Dioxane	ug/L	50 U	50 UJ	--	--	--	--	--
1,4-Naphthoquinone	ug/L	200 U	200 U	--	--	--	--	--
1-Naphthylamine	ug/L	10 U	10 UJ	--	--	--	--	--
2,3,4,6-Tetrachlorophenol	ug/L	50 U	50 U	--	--	--	--	--
2,4,5-Trichlorophenol	ug/L	10 U	10 U	--	--	--	--	--
2,4,6-Trichlorophenol	ug/L	5 U	5 U	--	--	--	--	--
2,4-Dichlorophenol	ug/L	5 U	5 U	--	--	--	--	--
2,4-Dimethylphenol	ug/L	5 U	5 U	--	--	--	--	--
2,4-Dinitrophenol	ug/L	50 UJ	50 U	--	--	--	--	--
2,4-Dinitrotoluene	ug/L	5 U	5 U	--	--	--	--	--
2,6-Dichlorophenol	ug/L	10 U	10 U	--	--	--	--	--
2,6-Dinitrotoluene	ug/L	5 U	5 U	--	--	--	--	--
2-Acetylaminofluorene	ug/L	20 U	20 UJ	--	--	--	--	--
2-Chloro-1,3-butadiene	ug/L	33 UJ	5 UJ	--	--	--	--	--
2-Chloronaphthalene	ug/L	10 U	10 U	--	--	--	--	--
2-Chlorophenol	ug/L	5 U	5 U	--	--	--	--	--
2-Methylnaphthalene	ug/L	5 U	5 U	--	--	--	--	--
2-Methylphenol	ug/L	5 U	5 U	--	--	--	--	--
2-Naphthylamine	ug/L	10 U	10 UJ	--	--	--	--	--
2-Nitroaniline	ug/L	50 U	50 U	--	--	--	--	--
2-Nitrophenol	ug/L	10 U	10 U	--	--	--	--	--
2-Picoline	ug/L	20 U	20 U	--	--	--	--	--
3,3'-Dichlorobenzidine	ug/L	20 U	20 U	--	--	--	--	--
3,3'-Dimethylbenzidine	ug/L	50 U	50 UJ	--	--	--	--	--
3-Chloropropene	ug/L	330 U	50 U	--	--	--	--	--
3-Methylcholanthrene	ug/L	100 U	100 U	--	--	--	--	--
3-Methylphenol	ug/L	10 U	10 U	--	--	--	--	--
3-Nitroaniline	ug/L	50 U	50 U	--	--	--	--	--
4,6-Dinitro-2-methylphenol	ug/L	50 U	50 U	--	--	--	--	--
4-Aminobiphenyl	ug/L	50 U	50 UJ	--	--	--	--	--
4-Bromophenyl phenyl ether	ug/L	5 U	5 U	--	--	--	--	--
4-Chloro-3-methylphenol	ug/L	5 U	5 U	--	--	--	--	--
4-Chloroaniline	ug/L	10 U	10 U	--	--	--	--	--

TABLE D.2
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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-1 CMSMW-1 19-Aug-99 Water Field Sample A9H210120001 16-Sep-99	CMSMW-2 CMSMW-2 19-Aug-99 Water Field Sample A9H210120003 16-Sep-99	CMSMW-3 CMSMW-3 19-Aug-99 Water Field Sample A9H210120007 16-Sep-99	CMSMW-4 CMSMW-4 20-Aug-99 Water Field Sample A9H240148001 16-Sep-99	CMSMW-5 CMSMW-5 23-Aug-99 Water Field Sample A9H250128004 13-Sep-99	CMSMW-6 CMSMW-6 23-Aug-99 Water Field Sample A9H250128005 13-Sep-99	CMSMW-7 CMSMW-7 24-Aug-99 Water Field Sample A9H260105001 13-Sep-99
Analyte	Units							
4-Chlorophenyl phenyl ether	ug/L	10 U	10 U	--	--	--	--	--
4-Methylphenol	ug/L	10 U	10 U	--	--	--	--	--
4-Nitroaniline	ug/L	50 U	50 U	--	--	--	--	--
4-Nitrophenol	ug/L	50 U	50 UJ	--	--	--	--	--
4-Nitroquinoline-1-oxide	ug/L	100 UR	100 UR	--	--	--	--	--
5-Nitro-o-toluidine	ug/L	10 U	10 U	--	--	--	--	--
7,12-Dimethylbenz(a)anthracene	ug/L	100 U	100 UJ	--	--	--	--	--
a,a-Dimethylphenethylamine	ug/L	50 U	50 U	--	--	--	--	--
Acenaphthene	ug/L	5 U	5 U	--	--	--	--	--
Acenaphthylene	ug/L	5 U	5 U	--	--	--	--	--
Acetophenone	ug/L	10 U	10 U	--	--	--	--	--
Aniline	ug/L	10 U	10 U	--	--	--	--	--
Anthracene	ug/L	5 U	5 U	--	--	--	--	--
Benzo(a)anthracene	ug/L	5 U	5 U	--	--	--	--	--
Benzo(a)pyrene	ug/L	5 U	5 U	--	--	--	--	--
Benzo(b)fluoranthene	ug/L	5 U	5 U	--	--	--	--	--
Benzo(ghi)perylene	ug/L	5 U	5 U	--	--	--	--	--
Benzo(k)fluoranthene	ug/L	5 U	5 U	--	--	--	--	--
Benzyl alcohol	ug/L	10 U	10 U	--	--	--	--	--
bis(2-Chloroethoxy)methane	ug/L	10 U	10 U	--	--	--	--	--
bis(2-Chloroethyl) ether	ug/L	5 U	5 U	--	--	--	--	--
bis(2-Chloroisopropyl) ether	ug/L	10 U	10 U	--	--	--	--	--
bis(2-Ethylhexyl) phthalate	ug/L	5 U	5 U	--	--	--	--	--
Butyl benzyl phthalate	ug/L	5 U	5 U	--	--	--	--	--
Chlorobenzilate	ug/L	10 UJ	10 UJ	--	--	--	--	--
Chrysene	ug/L	5 U	5 U	--	--	--	--	--
Diallate	ug/L	10 U	10 UJ	--	--	--	--	--
Dibenz(a,h)anthracene	ug/L	5 U	5 U	--	--	--	--	--
Dibenzofuran	ug/L	5 U	5 U	--	--	--	--	--
Diethyl phthalate	ug/L	5 U	5 U	--	--	--	--	--
Dimethoate	ug/L	200 U	200 U	--	--	--	--	--
Dimethyl phthalate	ug/L	5 U	5 U	--	--	--	--	--
Di-n-butyl phthalate	ug/L	5 U	5 U	--	--	--	--	--
Di-n-octyl phthalate	ug/L	10 U	10 U	--	--	--	--	--
Dinoseb	ug/L	10 U	10 U	--	--	--	--	--
Diphenylamine	ug/L	10 U	10 U	--	--	--	--	--
Ethyl methanesulfonate	ug/L	10 U	10 U	--	--	--	--	--
Fluoranthene	ug/L	5 U	5 U	--	--	--	--	--

TABLE D.2
GROUNDWATER ANALYTICAL DATA RESULTS
SEMIVOLATILE ORGANIC COMPOUNDS

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Field Sample ID: Location: Sample Date: Matrix: Sample Type: Lab Sample ID: Analysis Date:		CMSMW-1 CMSMW-1 19-Aug-99 Water Field Sample A9H210120001 16-Sep-99	CMSMW-2 CMSMW-2 19-Aug-99 Water Field Sample A9H210120003 16-Sep-99	CMSMW-3 CMSMW-3 19-Aug-99 Water Field Sample A9H210120007 16-Sep-99	CMSMW-4 CMSMW-4 20-Aug-99 Water Field Sample A9H240148001 16-Sep-99	CMSMW-5 CMSMW-5 23-Aug-99 Water Field Sample A9H250128004 13-Sep-99	CMSMW-6 CMSMW-6 23-Aug-99 Water Field Sample A9H250128005 13-Sep-99	CMSMW-7 CMSMW-7 24-Aug-99 Water Field Sample A9H260105001 13-Sep-99
Analyte	Units							
Fluorene	ug/L	5 U	5 U	--	--	--	--	--
Hexachlorobenzene	ug/L	5 U	5 U	--	--	--	--	--
Hexachlorobutadiene	ug/L	5 U	5 U	--	--	--	--	--
Hexachlorocyclopentadiene	ug/L	5 U	5 U	--	--	--	--	--
Hexachloroethane	ug/L	5 U	5 U	--	--	--	--	--
Hexachloropropene	ug/L	100 U	100 U	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	ug/L	5 U	5 U	--	--	--	--	--
Isophorone	ug/L	5 U	5 U	--	--	--	--	--
Isosafrole	ug/L	10 U	10 U	--	--	--	--	--
Methapyrilene	ug/L	100 U	100 U	--	--	--	--	--
Methyl methanesulfonate	ug/L	10 U	10 U	--	--	--	--	--
Naphthalene	ug/L	5 U	5 U	--	--	--	--	--
Nitrobenzene	ug/L	5 U	5 U	--	--	--	--	--
N-Nitrosodiethylamine	ug/L	10 U	10 U	--	--	--	--	--
N-Nitrosodimethylamine	ug/L	10 U	10 U	--	--	--	--	--
N-Nitrosodi-n-butylamine	ug/L	10 U	10 U	--	--	--	--	--
N-Nitrosodi-n-propylamine	ug/L	5 U	5 U	--	--	--	--	--
N-Nitrosodiphenylamine	ug/L	5 U	5 U	--	--	--	--	--
N-Nitrosomethylethylamine	ug/L	10 U	10 U	--	--	--	--	--
N-Nitrosomorpholine	ug/L	10 U	10 U	--	--	--	--	--
N-Nitrosopiperidine	ug/L	10 U	10 U	--	--	--	--	--
N-Nitrosopyrrolidine	ug/L	10 U	10 U	--	--	--	--	--
o-Toluidine	ug/L	10 U	10 U	--	--	--	--	--
p-Dimethylaminoazobenzene	ug/L	20 U	20 U	--	--	--	--	--
Pentachlorobenzene	ug/L	5 U	5 U	--	--	--	--	--
Pentachloroethane	ug/L	50 U	50 U	--	--	--	--	--
Pentachloronitrobenzene	ug/L	50 U	50 U	--	--	--	--	--
Pentachlorophenol	ug/L	50 U	50 U	--	--	--	--	--
Phenacetin	ug/L	50 U	50 U	--	--	--	--	--
Phenanthrene	ug/L	5 U	5 U	--	--	--	--	--
Phenol	ug/L	5 U	24	--	--	--	--	--
Pronamide	ug/L	20 U	20 U	--	--	--	--	--
Pyrene	ug/L	5 U	5 U	--	--	--	--	--
Pyridine	ug/L	10 U	10 U	--	--	--	--	--
Safrole	ug/L	10 U	10 U	--	--	--	--	--

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Field Sample ID: Location: Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-8 CMSMW-8 24-Aug-99 Water Field Sample A9H260105002 13-Sep-99	CMSMW-9 CMSMW-9 24-Aug-99 Water Field Sample A9H260105003 13-Sep-99	CMSMW-10 CMSMW-10 24-Aug-99 Water Field Sample A9H260105005 13-Sep-99	CMSMW-11 CMSMW-11 24-Aug-99 Water Field Sample A9H260105006 13-Sep-99	CMSMW-12 CMSMW-12 25-Aug-99 Water Field Sample A9H270119001 13-Sep-99	CMSMW-13S CMSMW-13S 23-Aug-99 Water Field Sample A9H250128008 13-Sep-99	CMSMW-13F CMSMW-13F 23-Aug-99 Water Field Sample A9H250128007 13-Sep-99
Analyte	Units							
SVOCs								
1,2,4,5-Tetrachlorobenzene	ug/L	--	--	--	--	100 U	5 U	5 U
1,2,4-Trichlorobenzene	ug/L	--	--	--	--	100 U	5 U	5 U
1,3,5-Trinitrobenzene	ug/L	--	--	--	--	1000 U	50 U	50 U
1,3-Dinitrobenzene	ug/L	--	--	--	--	200 U	10 U	10 U
1,4-Dioxane	ug/L	--	--	--	--	1000 U	50 U	50 U
1,4-Naphthoquinone	ug/L	--	--	--	--	4000 UJ	200 U	200 U
1-Naphthylamine	ug/L	--	--	--	--	200 U	10 U	10 U
2,3,4,6-Tetrachlorophenol	ug/L	--	--	--	--	1000 UJ	50 U	50 U
2,4,5-Trichlorophenol	ug/L	--	--	--	--	200 U	10 U	10 U
2,4,6-Trichlorophenol	ug/L	--	--	--	--	100 U	5 U	5 U
2,4-Dichlorophenol	ug/L	--	--	--	--	100 U	5 U	5 U
2,4-Dimethylphenol	ug/L	--	--	--	--	100 U	5.5	5 U
2,4-Dinitrophenol	ug/L	--	--	--	--	1000 U	50 U	50 U
2,4-Dinitrotoluene	ug/L	--	--	--	--	100 U	5 U	5 U
2,6-Dichlorophenol	ug/L	--	--	--	--	200 U	10 U	10 U
2,6-Dinitrotoluene	ug/L	--	--	--	--	100 U	5 U	5 U
2-Acetylaminofluorene	ug/L	--	--	--	--	400 U	20 U	20 U
2-Chloro-1,3-butadiene	ug/L	--	--	--	--	12 U	5 U	25 U
2-Chloronaphthalene	ug/L	--	--	--	--	200 U	10 U	10 U
2-Chlorophenol	ug/L	--	--	--	--	100 U	5 U	5 U
2-Methylnaphthalene	ug/L	--	--	--	--	100 U	5 U	5 U
2-Methylphenol	ug/L	--	--	--	--	100 U	5 U	5 U
2-Naphthylamine	ug/L	--	--	--	--	200 U	10 U	10 U
2-Nitroaniline	ug/L	--	--	--	--	1000 U	50 U	50 U
2-Nitrophenol	ug/L	--	--	--	--	200 U	10 U	10 U
2-Picoline	ug/L	--	--	--	--	400 U	29	20 U
3,3'-Dichlorobenzidine	ug/L	--	--	--	--	400 U	20 U	20 U
3,3'-Dimethylbenzidine	ug/L	--	--	--	--	1000 UJ	50 U	50 U
3-Chloropropene	ug/L	--	--	--	--	120 U	50 U	250 U
3-Methylcholanthrene	ug/L	--	--	--	--	2000 U	100 U	100 U
3-Methylphenol	ug/L	--	--	--	--	200 UJ	10 UJ	10 UJ
3-Nitroaniline	ug/L	--	--	--	--	1000 U	50 U	50 U
4,6-Dinitro-2-methylphenol	ug/L	--	--	--	--	1000 U	50 U	50 U
4-Aminobiphenyl	ug/L	--	--	--	--	1000 U	50 U	50 U
4-Bromophenyl phenyl ether	ug/L	--	--	--	--	100 U	5 U	5 U
4-Chloro-3-methylphenol	ug/L	--	--	--	--	100 U	5 U	5 U
4-Chloroaniline	ug/L	--	--	--	--	200 U	10 U	10 U

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-8 CMSMW-8 24-Aug-99 Water Field Sample A9H260105002 13-Sep-99	CMSMW-9 CMSMW-9 24-Aug-99 Water Field Sample A9H260105003 13-Sep-99	CMSMW-10 CMSMW-10 24-Aug-99 Water Field Sample A9H260105005 13-Sep-99	CMSMW-11 CMSMW-11 24-Aug-99 Water Field Sample A9H260105006 13-Sep-99	CMSMW-12 CMSMW-12 25-Aug-99 Water Field Sample A9H270119001 13-Sep-99	CMSMW-13S CMSMW-13S 23-Aug-99 Water Field Sample A9H250128008 13-Sep-99	CMSMW-13F CMSMW-13F 23-Aug-99 Water Field Sample A9H250128007 13-Sep-99
Analyte	Units							
4-Chlorophenyl phenyl ether	ug/L	--	--	--	--	200 U	10 U	10 U
4-Methylphenol	ug/L	--	--	--	--	200 U	10 U	10 U
4-Nitroaniline	ug/L	--	--	--	--	1000 U	50 U	50 U
4-Nitrophenol	ug/L	--	--	--	--	1000 U	50 U	50 U
4-Nitroquinoline-1-oxide	ug/L	--	--	--	--	2000 U	100 U	100 U
5-Nitro-o-toluidine	ug/L	--	--	--	--	200 U	10 U	10 U
7,12-Dimethylbenz(a)anthracene	ug/L	--	--	--	--	2000 U	100 U	100 U
a,a-Dimethylphenethylamine	ug/L	--	--	--	--	1000 U	50 U	50 U
Acenaphthene	ug/L	--	--	--	--	100 U	5 U	5 U
Acenaphthylene	ug/L	--	--	--	--	100 U	5 U	5 U
Acetophenone	ug/L	--	--	--	--	200 U	10 U	10 U
Aniline	ug/L	--	--	--	--	200 U	10 U	10 U
Anthracene	ug/L	--	--	--	--	100 U	5 U	5 U
Benzo(a)anthracene	ug/L	--	--	--	--	100 U	5 U	5 U
Benzo(a)pyrene	ug/L	--	--	--	--	100 U	5 U	5 U
Benzo(b)fluoranthene	ug/L	--	--	--	--	100 U	5 U	5 U
Benzo(ghi)perylene	ug/L	--	--	--	--	100 U	5 U	5 U
Benzo(k)fluoranthene	ug/L	--	--	--	--	100 U	5 U	5 U
Benzyl alcohol	ug/L	--	--	--	--	200 U	10 U	10 U
bis(2-Chloroethoxy)methane	ug/L	--	--	--	--	200 U	10 U	10 U
bis(2-Chloroethyl) ether	ug/L	--	--	--	--	100 U	5 U	5 U
bis(2-Chloroisopropyl) ether	ug/L	--	--	--	--	200 U	10 U	10 U
bis(2-Ethylhexyl) phthalate	ug/L	--	--	--	--	100 U	5 U	5 U
Butyl benzyl phthalate	ug/L	--	--	--	--	100 U	5 U	5 U
Chlorobenzilate	ug/L	--	--	--	--	200 U	10 U	10 U
Chrysene	ug/L	--	--	--	--	100 U	5 U	5 U
Diallate	ug/L	--	--	--	--	200 U	10 U	10 U
Dibenz(a,h)anthracene	ug/L	--	--	--	--	100 U	5 U	5 U
Dibenzofuran	ug/L	--	--	--	--	100 U	5 U	5 U
Diethyl phthalate	ug/L	--	--	--	--	100 U	5 U	5 U
Dimethoate	ug/L	--	--	--	--	4000 UJ	200 U	200 U
Dimethyl phthalate	ug/L	--	--	--	--	100 U	5 U	5 U
Di-n-butyl phthalate	ug/L	--	--	--	--	100 U	5 U	5 U
Di-n-octyl phthalate	ug/L	--	--	--	--	200 U	10 U	10 U
Dinoseb	ug/L	--	--	--	--	200 U	10 U	10 U
Diphenylamine	ug/L	--	--	--	--	200 U	10 U	10 U
Ethyl methanesulfonate	ug/L	--	--	--	--	200 U	10 U	10 U
Fluoranthene	ug/L	--	--	--	--	100 U	5 U	5 U

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-8 CMSMW-8 24-Aug-99 Water Field Sample A9H260105002 13-Sep-99	CMSMW-9 CMSMW-9 24-Aug-99 Water Field Sample A9H260105003 13-Sep-99	CMSMW-10 CMSMW-10 24-Aug-99 Water Field Sample A9H260105005 13-Sep-99	CMSMW-11 CMSMW-11 24-Aug-99 Water Field Sample A9H260105006 13-Sep-99	CMSMW-12 CMSMW-12 25-Aug-99 Water Field Sample A9H270119001 13-Sep-99	CMSMW-13S CMSMW-13S 23-Aug-99 Water Field Sample A9H250128008 13-Sep-99	CMSMW-13F CMSMW-13F 23-Aug-99 Water Field Sample A9H250128007 13-Sep-99
Analyte	Units							
Fluorene	ug/L	--	--	--	--	100 U	5 U	5 U
Hexachlorobenzene	ug/L	--	--	--	--	100 U	5 U	5 U
Hexachlorobutadiene	ug/L	--	--	--	--	100 U	5 U	5 U
Hexachlorocyclopentadiene	ug/L	--	--	--	--	100 U	5 U	5 U
Hexachloroethane	ug/L	--	--	--	--	100 U	5 U	5 U
Hexachloropropene	ug/L	--	--	--	--	2000 U	100 U	100 U
Indeno(1,2,3-cd)pyrene	ug/L	--	--	--	--	100 U	5 U	5 U
Isophorone	ug/L	--	--	--	--	100 U	5 U	5 U
Isosafrole	ug/L	--	--	--	--	200 U	10 U	10 U
Methapyrilene	ug/L	--	--	--	--	2000 UR	100 UR	100 UR
Methyl methanesulfonate	ug/L	--	--	--	--	200 U	10 U	10 U
Naphthalene	ug/L	--	--	--	--	100 U	5 U	19
Nitrobenzene	ug/L	--	--	--	--	100 U	5 U	5 U
N-Nitrosodiethylamine	ug/L	--	--	--	--	200 U	10 U	10 U
N-Nitrosodimethylamine	ug/L	--	--	--	--	200 U	10 U	10 U
N-Nitrosodi-n-butylamine	ug/L	--	--	--	--	200 U	10 U	10 U
N-Nitrosodi-n-propylamine	ug/L	--	--	--	--	100 U	5 U	5 U
N-Nitrosodiphenylamine	ug/L	--	--	--	--	100 U	5 U	5 U
N-Nitrosomethylethylamine	ug/L	--	--	--	--	200 U	10 U	10 U
N-Nitrosomorpholine	ug/L	--	--	--	--	200 U	10 U	10 U
N-Nitrosopiperidine	ug/L	--	--	--	--	200 U	10 U	10 U
N-Nitrosopyrrolidine	ug/L	--	--	--	--	200 U	10 U	10 U
o-Toluidine	ug/L	--	--	--	--	200 U	10 U	10 U
p-Dimethylaminoazobenzene	ug/L	--	--	--	--	400 U	20 U	20 U
Pentachlorobenzene	ug/L	--	--	--	--	100 U	5 U	5 U
Pentachloroethane	ug/L	--	--	--	--	1000 U	50 U	50 U
Pentachloronitrobenzene	ug/L	--	--	--	--	1000 U	50 U	50 U
Pentachlorophenol	ug/L	--	--	--	--	1000 U	50 U	50 U
Phenacetin	ug/L	--	--	--	--	1000 U	50 U	50 U
Phenanthrene	ug/L	--	--	--	--	100 U	5 U	5 U
Phenol	ug/L	--	--	--	--	100 U	5 U	5 U
Pronamide	ug/L	--	--	--	--	400 U	20 U	20 U
Pyrene	ug/L	--	--	--	--	100 U	5 U	5 U
Pyridine	ug/L	--	--	--	--	200 U	3.6 J	10 U
Safrole	ug/L	--	--	--	--	200 U	10 U	10 U

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Analyte	Units							
SVOCs								
1,2,4,5-Tetrachlorobenzene	ug/L	5 U	5 U	5 U	--	--	25 U	--
1,2,4-Trichlorobenzene	ug/L	5 U	5 U	5 U	--	--	25 U	--
1,3,5-Trinitrobenzene	ug/L	50 U	50 U	50 U	--	--	250 U	--
1,3-Dinitrobenzene	ug/L	10 U	10 U	10 U	--	--	50 U	--
1,4-Dioxane	ug/L	50 U	50 U	4.8 I	--	--	120 I	--
1,4-Naphthoquinone	ug/L	200 UJ	200 UJ	200 U	--	--	1000 U	--
1-Naphthylamine	ug/L	10 U	10 U	10 UJ	--	--	50 UJ	--
2,3,4,6-Tetrachlorophenol	ug/L	50 UJ	50 UJ	50 U	--	--	250 U	--
2,4,5-Trichlorophenol	ug/L	10 U	10 U	10 U	--	--	50 U	--
2,4,6-Trichlorophenol	ug/L	5 U	5 U	5 U	--	--	25 U	--
2,4-Dichlorophenol	ug/L	5 U	5 U	5 U	--	--	25 U	--
2,4-Dimethylphenol	ug/L	5 U	5 U	5 U	--	--	25 U	--
2,4-Dinitrophenol	ug/L	50 U	50 U	50 U	--	--	250 U	--
2,4-Dinitrotoluene	ug/L	5 U	5 U	5 U	--	--	25 U	--
2,6-Dichlorophenol	ug/L	10 U	10 U	10 U	--	--	50 U	--
2,6-Dinitrotoluene	ug/L	5 U	5 U	5 U	--	--	25 U	--
2-Acetylaminofluorene	ug/L	20 U	20 U	20 UJ	--	--	100 UJ	--
2-Chloro-1,3-butadiene	ug/L	5 U	5 U	5 UJ	--	--	20 U	--
2-Chloronaphthalene	ug/L	10 U	10 U	10 U	--	--	50 U	--
2-Chlorophenol	ug/L	5 U	5 U	5 U	--	--	25 U	--
2-Methylnaphthalene	ug/L	5 U	5 U	5 U	--	--	25 U	--
2-Methylphenol	ug/L	5 U	5 U	5 U	--	--	25 U	--
2-Naphthylamine	ug/L	10 U	10 U	10 UJ	--	--	50 UJ	--
2-Nitroaniline	ug/L	50 U	50 U	50 U	--	--	250 U	--
2-Nitrophenol	ug/L	10 U	10 U	10 U	--	--	50 U	--
2-Picoline	ug/L	20 U	20 U	20 U	--	--	100 U	--
3,3'-Dichlorobenzidine	ug/L	20 U	20 U	20 U	--	--	100 U	--
3,3'-Dimethylbenzidine	ug/L	50 UJ	50 UJ	50 UJ	--	--	250 UJ	--
3-Chloropropene	ug/L	50 U	50 U	50 U	--	--	200 U	--
3-Methylcholanthrene	ug/L	100 U	100 U	100 UJ	--	--	500 UJ	--
3-Methylphenol	ug/L	10 UJ	10 UJ	10 U	--	--	50 U	--
3-Nitroaniline	ug/L	50 U	50 U	50 U	--	--	250 U	--
4,6-Dinitro-2-methylphenol	ug/L	50 U	50 U	50 U	--	--	250 U	--
4-Aminobiphenyl	ug/L	50 U	50 U	50 UJ	--	--	250 UJ	--
4-Bromophenyl phenyl ether	ug/L	5 U	5 U	5 U	--	--	25 U	--
4-Chloro-3-methylphenol	ug/L	5 U	5 U	5 U	--	--	25 U	--
4-Chloroaniline	ug/L	10 U	10 U	10 U	--	--	50 U	--

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-14S CMSMW-14S 25-Aug-99 Water Field Sample A9H270119002 13-Sep-99	CMSMW-39S CMSMW-39S 25-Aug-99 Water Field Sample A9H270119003 13-Sep-99	CMSMW-15 CMSMW-15 19-Aug-99 Water Field Sample A9H210120005 16-Sep-99	CMSMW-16F CMSMW-16F 24-Aug-99 Water Field Sample A9H260105007 13-Sep-99	CMSMW-18 CMSMW-18 24-Aug-99 Water Field Sample A9H260105004 13-Sep-99	RFIMW-1 RFIMW-1 19-Aug-99 Water Field Sample A9H210120006 16-Sep-99	RFIMW-4 RFIMW-4 20-Aug-99 Water Field Sample A9H240148004 16-Sep-99
Analyte	Units							
4-Chlorophenyl phenyl ether	ug/L	10 U	10 U	10 U	--	--	50 U	--
4-Methylphenol	ug/L	10 U	10 U	10 U	--	--	50 U	--
4-Nitroaniline	ug/L	50 U	50 U	50 U	--	--	250 U	--
4-Nitrophenol	ug/L	50 U	50 U	50 UJ	--	--	250 UJ	--
4-Nitroquinoline-1-oxide	ug/L	100 U	100 U	100 UR	--	--	500 UR	--
5-Nitro-o-toluidine	ug/L	10 U	10 U	10 U	--	--	50 U	--
7,12-Dimethylbenz(a)anthracene	ug/L	100 U	100 U	100 UJ	--	--	500 UJ	--
a,a-Dimethylphenethylamine	ug/L	50 U	50 U	50 U	--	--	250 U	--
Acenaphthene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Acenaphthylene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Acetophenone	ug/L	10 U	10 U	10 U	--	--	50 U	--
Aniline	ug/L	10 U	10 U	10 U	--	--	50 U	--
Anthracene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Benzo(a)anthracene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Benzo(a)pyrene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Benzo(b)fluoranthene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Benzo(ghi)perylene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Benzo(k)fluoranthene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Benzyl alcohol	ug/L	10 U	10 U	10 U	--	--	50 U	--
bis(2-Chloroethoxy)methane	ug/L	10 U	10 U	10 U	--	--	50 U	--
bis(2-Chloroethyl) ether	ug/L	5 U	5 U	5 U	--	--	25 U	--
bis(2-Chloroisopropyl) ether	ug/L	6.5 J	5.3 J	10 U	--	--	50 U	--
bis(2-Ethylhexyl) phthalate	ug/L	5 U	5 U	5 U	--	--	25 U	--
Butyl benzyl phthalate	ug/L	5 U	5 U	5 U	--	--	25 U	--
Chlorobenzilate	ug/L	10 U	10 U	10 UJ	--	--	50 UJ	--
Chrysene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Diallate	ug/L	10 U	10 U	10 UJ	--	--	50 UJ	--
Dibenz(a,h)anthracene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Dibenzofuran	ug/L	5 U	5 U	5 U	--	--	25 U	--
Diethyl phthalate	ug/L	5 U	5 U	5 U	--	--	25 U	--
Dimethoate	ug/L	200 UJ	200 UJ	200 U	--	--	1000 U	--
Dimethyl phthalate	ug/L	5 U	5 U	5 U	--	--	25 U	--
Di-n-butyl phthalate	ug/L	5 U	5 U	5 U	--	--	25 U	--
Di-n-octyl phthalate	ug/L	10 U	10 U	10 U	--	--	50 U	--
Dinoseb	ug/L	10 U	10 U	10 U	--	--	50 U	--
Diphenylamine	ug/L	10 U	10 U	10 U	--	--	50 U	--
Ethyl methanesulfonate	ug/L	10 U	10 U	10 U	--	--	50 U	--
Fluoranthene	ug/L	5 U	5 U	5 U	--	--	25 U	--

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Analyte	Units							
Fluorene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Hexachlorobenzene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Hexachlorobutadiene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Hexachlorocyclopentadiene	ug/L	5 UJ	5 UJ	5 U	--	--	25 U	--
Hexachloroethane	ug/L	5 U	5 U	5 U	--	--	25 U	--
Hexachloropropene	ug/L	100 UJ	100 UJ	100 U	--	--	500 U	--
Indeno(1,2,3-cd)pyrene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Isophorone	ug/L	5 U	5 U	5 U	--	--	25 U	--
Isosafrole	ug/L	10 U	10 U	10 U	--	--	50 U	--
Methapyrilene	ug/L	100 UR	100 UR	100 U	--	--	500 U	--
Methyl methanesulfonate	ug/L	10 U	10 U	10 U	--	--	50 U	--
Naphthalene	ug/L	5.9	5.4	5 U	--	--	25 U	--
Nitrobenzene	ug/L	5 U	5 U	5 U	--	--	25 U	--
N-Nitrosodiethylamine	ug/L	10 U	10 U	10 U	--	--	50 U	--
N-Nitrosodimethylamine	ug/L	10 U	10 U	10 U	--	--	50 U	--
N-Nitrosodi-n-butylamine	ug/L	10 U	10 U	10 U	--	--	50 U	--
N-Nitrosodi-n-propylamine	ug/L	5 U	5 U	5 U	--	--	25 U	--
N-Nitrosodiphenylamine	ug/L	5 U	5 U	5 U	--	--	25 U	--
N-Nitrosomethylethylamine	ug/L	10 U	10 U	10 U	--	--	50 U	--
N-Nitrosomorpholine	ug/L	10 U	10 U	10 U	--	--	50 U	--
N-Nitrosopiperidine	ug/L	10 U	10 U	10 U	--	--	50 U	--
N-Nitrosopyrrolidine	ug/L	10 U	10 U	10 U	--	--	50 U	--
o-Toluidine	ug/L	10 U	10 U	10 U	--	--	50 U	--
p-Dimethylaminoazobenzene	ug/L	20 U	20 U	20 U	--	--	100 U	--
Pentachlorobenzene	ug/L	5 UJ	5 UJ	5 U	--	--	25 U	--
Pentachloroethane	ug/L	50 U	50 U	50 U	--	--	250 U	--
Pentachloronitrobenzene	ug/L	50 U	50 U	50 U	--	--	250 U	--
Pentachlorophenol	ug/L	50 U	50 U	50 U	--	--	250 U	--
Phenacetin	ug/L	50 U	50 U	50 U	--	--	250 U	--
Phenanthrene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Phenol	ug/L	5 U	5 U	5 U	--	--	25 U	--
Pronamide	ug/L	20 U	20 U	20 U	--	--	100 U	--
Pyrene	ug/L	5 U	5 U	5 U	--	--	25 U	--
Pyridine	ug/L	10 U	10 U	10 U	--	--	50 U	--
Safrole	ug/L	10 U	10 U	10 U	--	--	50 U	--

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Analyte	Units							
SVOCs								
1,2,4,5-Tetrachlorobenzene	ug/L	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	ug/L	--	--	--	--	--	--	--
1,3,5-Trinitrobenzene	ug/L	--	--	--	--	--	--	--
1,3-Dinitrobenzene	ug/L	--	--	--	--	--	--	--
1,4-Dioxane	ug/L	--	--	--	--	--	--	--
1,4-Naphthoquinone	ug/L	--	--	--	--	--	--	--
1-Naphthylamine	ug/L	--	--	--	--	--	--	--
2,3,4,6-Tetrachlorophenol	ug/L	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	ug/L	--	--	--	--	--	--	--
2,4,6-Trichlorophenol	ug/L	--	--	--	--	--	--	--
2,4-Dichlorophenol	ug/L	--	--	--	--	--	--	--
2,4-Dimethylphenol	ug/L	--	--	--	--	--	--	--
2,4-Dinitrophenol	ug/L	--	--	--	--	--	--	--
2,4-Dinitrotoluene	ug/L	--	--	--	--	--	--	--
2,6-Dichlorophenol	ug/L	--	--	--	--	--	--	--
2,6-Dinitrotoluene	ug/L	--	--	--	--	--	--	--
2-Acetylaminofluorene	ug/L	--	--	--	--	--	--	--
2-Chloro-1,3-butadiene	ug/L	--	--	--	--	--	--	--
2-Chloronaphthalene	ug/L	--	--	--	--	--	--	--
2-Chlorophenol	ug/L	--	--	--	--	--	--	--
2-Methylnaphthalene	ug/L	--	--	--	--	--	--	--
2-Methylphenol	ug/L	--	--	--	--	--	--	--
2-Naphthylamine	ug/L	--	--	--	--	--	--	--
2-Nitroaniline	ug/L	--	--	--	--	--	--	--
2-Nitrophenol	ug/L	--	--	--	--	--	--	--
2-Picoline	ug/L	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	ug/L	--	--	--	--	--	--	--
3,3'-Dimethylbenzidine	ug/L	--	--	--	--	--	--	--
3-Chloropropene	ug/L	--	--	--	--	--	--	--
3-Methylcholanthrene	ug/L	--	--	--	--	--	--	--
3-Methylphenol	ug/L	--	--	--	--	--	--	--
3-Nitroaniline	ug/L	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	ug/L	--	--	--	--	--	--	--
4-Aminobiphenyl	ug/L	--	--	--	--	--	--	--
4-Bromophenyl phenyl ether	ug/L	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	ug/L	--	--	--	--	--	--	--
4-Chloroaniline	ug/L	--	--	--	--	--	--	--

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		RFIMW-5 RFIMW-5 20-Aug-99 Water Field Sample A9H240148005 16-Sep-99	RFIMW-30 RFIMW-30 20-Aug-99 Water Field Sample A9H240148006 16-Sep-99	RFIMW-6 RFIMW-6 23-Aug-99 Water Field Sample A9H250128003 13-Sep-99	RFIMW-7 RFIMW-7 23-Aug-99 Water Field Sample A9H250128006 13-Sep-99	RFIMW-13 RFIMW-13 19-Aug-99 Water Field Sample A9H210120008 16-Sep-99	RFIMW-14 RFIMW-14 20-Aug-99 Water Field Sample A9H240148002 16-Sep-99	RFIMW-39 RFIMW-39 20-Aug-99 Water Field Sample A9H240148003 16-Sep-99
Analyte	Units							
4-Chlorophenyl phenyl ether	ug/L	--	--	--	--	--	--	--
4-Methylphenol	ug/L	--	--	--	--	--	--	--
4-Nitroaniline	ug/L	--	--	--	--	--	--	--
4-Nitrophenol	ug/L	--	--	--	--	--	--	--
4-Nitroquinoline-1-oxide	ug/L	--	--	--	--	--	--	--
5-Nitro-o-toluidine	ug/L	--	--	--	--	--	--	--
7,12-Dimethylbenz(a)anthracene	ug/L	--	--	--	--	--	--	--
a,a-Dimethylphenethylamine	ug/L	--	--	--	--	--	--	--
Acenaphthene	ug/L	--	--	--	--	--	--	--
Acenaphthylene	ug/L	--	--	--	--	--	--	--
Acetophenone	ug/L	--	--	--	--	--	--	--
Aniline	ug/L	--	--	--	--	--	--	--
Anthracene	ug/L	--	--	--	--	--	--	--
Benzo(a)anthracene	ug/L	--	--	--	--	--	--	--
Benzo(a)pyrene	ug/L	--	--	--	--	--	--	--
Benzo(b)fluoranthene	ug/L	--	--	--	--	--	--	--
Benzo(ghi)perylene	ug/L	--	--	--	--	--	--	--
Benzo(k)fluoranthene	ug/L	--	--	--	--	--	--	--
Benzyl alcohol	ug/L	--	--	--	--	--	--	--
bis(2-Chloroethoxy)methane	ug/L	--	--	--	--	--	--	--
bis(2-Chloroethyl) ether	ug/L	--	--	--	--	--	--	--
bis(2-Chloroisopropyl) ether	ug/L	--	--	--	--	--	--	--
bis(2-Ethylhexyl) phthalate	ug/L	--	--	--	--	--	--	--
Butyl benzyl phthalate	ug/L	--	--	--	--	--	--	--
Chlorobenzilate	ug/L	--	--	--	--	--	--	--
Chrysene	ug/L	--	--	--	--	--	--	--
Diallate	ug/L	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	ug/L	--	--	--	--	--	--	--
Dibenzofuran	ug/L	--	--	--	--	--	--	--
Diethyl phthalate	ug/L	--	--	--	--	--	--	--
Dimethoate	ug/L	--	--	--	--	--	--	--
Dimethyl phthalate	ug/L	--	--	--	--	--	--	--
Di-n-butyl phthalate	ug/L	--	--	--	--	--	--	--
Di-n-octyl phthalate	ug/L	--	--	--	--	--	--	--
Dinoseb	ug/L	--	--	--	--	--	--	--
Diphenylamine	ug/L	--	--	--	--	--	--	--
Ethyl methanesulfonate	ug/L	--	--	--	--	--	--	--
Fluoranthene	ug/L	--	--	--	--	--	--	--

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Analyte	Units							
Fluorene	ug/L	--	--	--	--	--	--	--
Hexachlorobenzene	ug/L	--	--	--	--	--	--	--
Hexachlorobutadiene	ug/L	--	--	--	--	--	--	--
Hexachlorocyclopentadiene	ug/L	--	--	--	--	--	--	--
Hexachloroethane	ug/L	--	--	--	--	--	--	--
Hexachloropropene	ug/L	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	ug/L	--	--	--	--	--	--	--
Isophorone	ug/L	--	--	--	--	--	--	--
Isosafrole	ug/L	--	--	--	--	--	--	--
Methapyrilene	ug/L	--	--	--	--	--	--	--
Methyl methanesulfonate	ug/L	--	--	--	--	--	--	--
Naphthalene	ug/L	--	--	--	--	--	--	--
Nitrobenzene	ug/L	--	--	--	--	--	--	--
N-Nitrosodiethylamine	ug/L	--	--	--	--	--	--	--
N-Nitrosodimethylamine	ug/L	--	--	--	--	--	--	--
N-Nitrosodi-n-butylamine	ug/L	--	--	--	--	--	--	--
N-Nitrosodi-n-propylamine	ug/L	--	--	--	--	--	--	--
N-Nitrosodiphenylamine	ug/L	--	--	--	--	--	--	--
N-Nitrosomethylethylamine	ug/L	--	--	--	--	--	--	--
N-Nitrosomorpholine	ug/L	--	--	--	--	--	--	--
N-Nitrosopiperidine	ug/L	--	--	--	--	--	--	--
N-Nitrosopyrrolidine	ug/L	--	--	--	--	--	--	--
o-Toluidine	ug/L	--	--	--	--	--	--	--
p-Dimethylaminoazobenzene	ug/L	--	--	--	--	--	--	--
Pentachlorobenzene	ug/L	--	--	--	--	--	--	--
Pentachloroethane	ug/L	--	--	--	--	--	--	--
Pentachloronitrobenzene	ug/L	--	--	--	--	--	--	--
Pentachlorophenol	ug/L	--	--	--	--	--	--	--
Phenacetin	ug/L	--	--	--	--	--	--	--
Phenanthrene	ug/L	--	--	--	--	--	--	--
Phenol	ug/L	--	--	--	--	--	--	--
Pronamide	ug/L	--	--	--	--	--	--	--
Pyrene	ug/L	--	--	--	--	--	--	--
Pyridine	ug/L	--	--	--	--	--	--	--
Safrole	ug/L	--	--	--	--	--	--	--

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Analyte	Units				
SVOCs					
1,2,4,5-Tetrachlorobenzene	ug/L	300 U	5 U	5 U	100 U
1,2,4-Trichlorobenzene	ug/L	300 U	5 U	5 U	100 U
1,3,5-Trinitrobenzene	ug/L	3000 U	50 U	50 U	1000 U
1,3-Dinitrobenzene	ug/L	600 U	10 U	10 U	200 U
1,4-Dioxane	ug/L	87 J	50 UJ	50 U	1000 U
1,4-Naphthoquinone	ug/L	12000 U	200 U	200 UJ	4000 U
1-Naphthylamine	ug/L	600 UJ	10 UJ	10 U	200 U
2,3,4,6-Tetrachlorophenol	ug/L	3000 U	50 U	50 UR	1000 U
2,4,5-Trichlorophenol	ug/L	600 U	10 U	10 UR	200 U
2,4,6-Trichlorophenol	ug/L	300 U	5 U	5 UR	100 U
2,4-Dichlorophenol	ug/L	300 U	5 U	5 UR	100 U
2,4-Dimethylphenol	ug/L	300 U	5 U	5 UR	100 U
2,4-Dinitrophenol	ug/L	3000 U	50 U	50 UR	1000 U
2,4-Dinitrotoluene	ug/L	300 U	5 U	5 U	100 U
2,6-Dichlorophenol	ug/L	600 U	10 U	10 UR	200 U
2,6-Dinitrotoluene	ug/L	300 U	5 U	5 U	100 U
2-Acetylaminofluorene	ug/L	1200 UJ	20 U	20 U	400 U
2-Chloro-1,3-butadiene	ug/L	100 UJ	1 UJ	1 U	25 U
2-Chloronaphthalene	ug/L	600 U	10 U	10 U	200 U
2-Chlorophenol	ug/L	300 U	5 U	5 UR	100 U
2-Methylnaphthalene	ug/L	300 U	5 U	5 U	100 U
2-Methylphenol	ug/L	300 U	5 U	5 UR	100 U
2-Naphthylamine	ug/L	600 UJ	10 UJ	10 U	200 U
2-Nitroaniline	ug/L	3000 U	50 U	50 U	1000 U
2-Nitrophenol	ug/L	600 U	10 U	10 UR	200 U
2-Picoline	ug/L	1200 U	20 U	20 U	400 U
3,3'-Dichlorobenzidine	ug/L	1200 U	20 U	20 U	400 U
3,3'-Dimethylbenzidine	ug/L	3000 UJ	50 U	50 U	1000 U
3-Chloropropene	ug/L	1000 UJ	10 U	10 U	250 U
3-Methylcholanthrene	ug/L	6000 UJ	100 U	100 U	2000 U
3-Methylphenol	ug/L	600 U	10 U	10 UR	200 UJ
3-Nitroaniline	ug/L	3000 U	50 U	50 U	1000 U
4,6-Dinitro-2-methylphenol	ug/L	3000 U	50 U	50 UR	1000 U
4-Aminobiphenyl	ug/L	3000 UJ	50 UJ	50 U	1000 U
4-Bromophenyl phenyl ether	ug/L	300 U	5 U	5 U	100 U
4-Chloro-3-methylphenol	ug/L	300 U	5 U	5 UR	100 U
4-Chloroaniline	ug/L	600 U	10 U	10 U	200 U

TABLE D.2
GROUNDWATER ANALYTICAL DATA RESULTS
SEMIVOLATILE ORGANIC COMPOUNDS

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Analyte	Units				
4-Chlorophenyl phenyl ether	ug/L	600 U	10 U	10 U	200 U
4-Methylphenol	ug/L	600 U	10 U	10 UR	200 U
4-Nitroaniline	ug/L	3000 U	50 U	50 U	1000 U
4-Nitrophenol	ug/L	3000 UJ	50 UJ	50 UR	1000 U
4-Nitroquinoline-1-oxide	ug/L	6000 UR	100 UR	100 U	2000 U
5-Nitro-o-toluidine	ug/L	600 U	10 U	10 U	200 U
7,12-Dimethylbenz(a)anthracene	ug/L	6000 UJ	100 UJ	100 U	2000 U
a,a-Dimethylphenethylamine	ug/L	3000 U	50 U	50 U	1000 U
Acenaphthene	ug/L	300 U	5 U	5 U	100 U
Acenaphthylene	ug/L	300 U	5 U	5 U	100 U
Acetophenone	ug/L	600 U	10 U	10 U	200 U
Aniline	ug/L	600 U	10 U	10 U	200 U
Anthracene	ug/L	300 U	5 U	5 U	100 U
Benzo(a)anthracene	ug/L	300 U	3.3 J	5 U	100 U
Benzo(a)pyrene	ug/L	300 U	5 U	5 U	100 U
Benzo(b)fluoranthene	ug/L	300 U	5 U	5 U	100 U
Benzo(ghi)perylene	ug/L	300 U	5 U	5 U	100 U
Benzo(k)fluoranthene	ug/L	300 U	5 U	5 U	100 U
Benzyl alcohol	ug/L	600 U	10 U	10 U	200 U
bis(2-Chloroethoxy)methane	ug/L	600 U	10 U	10 U	200 U
bis(2-Chloroethyl) ether	ug/L	300 U	5 U	5 U	100 U
bis(2-Chloroisopropyl) ether	ug/L	600 U	10 U	10 U	200 U
bis(2-Ethylhexyl) phthalate	ug/L	300 U	5 U	5 U	100 U
Butyl benzyl phthalate	ug/L	300 U	5 U	5 U	100 U
Chlorobenzilate	ug/L	600 UJ	10 U	10 U	200 U
Chrysene	ug/L	300 U	5 U	5 U	100 U
Diallate	ug/L	600 UJ	10 UJ	10 U	200 U
Dibenz(a,h)anthracene	ug/L	300 U	5 U	5 U	100 U
Dibenzofuran	ug/L	300 U	5 U	5 U	100 U
Diethyl phthalate	ug/L	300 U	5 U	5 U	100 U
Dimethoate	ug/L	12000 U	200 U	200 UJ	4000 U
Dimethyl phthalate	ug/L	300 U	5 U	5 U	100 U
Di-n-butyl phthalate	ug/L	300 U	5 U	5 U	100 U
Di-n-octyl phthalate	ug/L	600 U	10 U	10 U	200 U
Dinoseb	ug/L	600 U	10 U	10 U	200 U
Diphenylamine	ug/L	600 U	10 U	10 U	200 U
Ethyl methanesulfonate	ug/L	600 U	10 U	10 U	200 U
Fluoranthene	ug/L	300 U	4.5 J	5 U	100 U

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SEMIVOLATILE ORGANIC COMPOUNDS

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		RFIMW-22 RFIMW-22 19-Aug-99 Water Field Sample A9H210120004 16-Sep-99	RFIMW-23 RFIMW-23 19-Aug-99 Water Field Sample A9H210120002 16-Sep-99	RFIMW-29 RFIMW-29 23-Aug-99 Water Field Sample A9H250128001 13-Sep-99	PM4NA PM4NA 23-Aug-99 Water Field Sample A9H250128002 13-Sep-99
Analyte	Units				
Fluorene	ug/L	300 U	5 U	5 U	100 U
Hexachlorobenzene	ug/L	300 U	5 U	5 U	100 U
Hexachlorobutadiene	ug/L	300 U	5 U	5 U	100 U
Hexachlorocyclopentadiene	ug/L	300 U	5 U	5 U	100 U
Hexachloroethane	ug/L	300 U	5 U	5 U	100 U
Hexachloropropene	ug/L	6000 U	100 U	100 U	2000 U
Indeno(1,2,3-cd)pyrene	ug/L	300 U	5 U	5 U	100 U
Isophorone	ug/L	300 U	5 U	5 U	100 U
Isosafrole	ug/L	600 U	10 U	10 U	200 U
Methapyrilene	ug/L	6000 U	100 U	100 UR	2000 UR
Methyl methanesulfonate	ug/L	600 U	10 U	10 U	200 U
Naphthalene	ug/L	300 U	5 U	5 U	100 U
Nitrobenzene	ug/L	300 U	5 U	5 U	100 U
N-Nitrosodiethylamine	ug/L	600 U	10 U	10 U	200 U
N-Nitrosodimethylamine	ug/L	600 U	10 U	10 U	200 U
N-Nitrosodi-n-butylamine	ug/L	600 U	10 U	10 U	200 U
N-Nitrosodi-n-propylamine	ug/L	300 U	5 U	5 U	100 U
N-Nitrosodiphenylamine	ug/L	300 U	5 U	5 U	100 U
N-Nitrosomethylethylamine	ug/L	600 U	10 U	10 U	200 U
N-Nitrosomorpholine	ug/L	600 U	10 U	10 U	200 U
N-Nitrosopiperidine	ug/L	600 U	10 U	10 U	200 U
N-Nitrosopyrrolidine	ug/L	600 U	10 U	10 U	200 U
o-Toluidine	ug/L	600 U	10 U	10 U	200 U
p-Dimethylaminoazobenzene	ug/L	1200 U	20 U	20 U	400 U
Pentachlorobenzene	ug/L	300 U	5 U	5 UJ	100 UJ
Pentachloroethane	ug/L	3000 U	50 U	50 U	1000 U
Pentachloronitrobenzene	ug/L	3000 U	50 U	50 U	1000 U
Pentachlorophenol	ug/L	3000 U	50 U	50 UR	1000 U
Phenacetin	ug/L	3000 U	50 U	50 U	1000 U
Phenanthrene	ug/L	300 U	5 U	5 U	100 U
Phenol	ug/L	220 J	5 U	5 UR	100 U
Pronamide	ug/L	1200 U	20 U	20 U	400 U
Pyrene	ug/L	300 U	9.6	5 U	100 U
Pyridine	ug/L	600 U	10 U	10 U	200 U
Safrole	ug/L	600 U	10 U	10 U	200 U

TABLE D.3
GROUNDWATER ANALYTICAL DATA RESULTS
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Field Sample ID: Location: Sample Date: Matrix: Sample Type: Lab Sample ID: Analysis Date:		CMSMW-1 CMSMW-1 19-Aug-99 Water Field Sample A9H210120001 16-Sep-99	CMSMW-2 CMSMW-2 19-Aug-99 Water Field Sample A9H210120003 16-Sep-99	CMSMW-3 CMSMW-3 19-Aug-99 Water Field Sample A9H210120007 16-Sep-99	CMSMW-4 CMSMW-4 20-Aug-99 Water Field Sample A9H240148001 16-Sep-99	CMSMW-5 CMSMW-5 23-Aug-99 Water Field Sample A9H250128004 13-Sep-99	CMSMW-6 CMSMW-6 23-Aug-99 Water Field Sample A9H250128005 13-Sep-99	CMSMW-7 CMSMW-7 24-Aug-99 Water Field Sample A9H260105001 13-Sep-99
Analyte	Units							
Non-regulated compounds								
Calcium	mg/L	539	420	404	857	1710	2230	451
Chemical Oxygen Demand (COD)	mg/L	49.2	147	247	127	125	204	1560
Hardness, as CaCO ₃	mg/L	1700	1000	1300	2700	4900	6700	1500
Total Alkalinity	mg/L	53	880	370	300	1300	710	1900
Total Dissolved Solids	mg/L	3200	2000	3100	2900	4400 J	21000 J	5700
Total Organic Carbon	mg/L	12 J	39 J	33 J	49 J	19 J	7 J	98 J
Total Solids (Residue)	mg/L	7800 J	2100	3800	3800	7400 J	25000 J	7800

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-8 CMSMW-8 24-Aug-99 Water Field Sample A9H260105002 13-Sep-99	CMSMW-9 CMSMW-9 24-Aug-99 Water Field Sample A9H260105003 13-Sep-99	CMSMW-10 CMSMW-10 24-Aug-99 Water Field Sample A9H260105005 13-Sep-99	CMSMW-11 CMSMW-11 24-Aug-99 Water Field Sample A9H260105006 13-Sep-99	CMSMW-12 CMSMW-12 25-Aug-99 Water Field Sample A9H270119001 13-Sep-99	CMSMW-13S CMSMW-12S 23-Aug-99 Water Field Sample A9H250128008 13-Sep-99	CMSMW-13F CMSMW-13F 23-Aug-99 Water Field Sample A9H250128007 13-Sep-99
Analyte	Units							
Non-regulated compounds								
Calcium	mg/L	112	938	612	340	73.1	46.5	187
Chemical Oxygen Demand (COD)	mg/L	250	2000	169	276	844	910	206
Hardness, as CaCO ₃	mg/L	400	2900	1800	1400	590	250	1000
Total Alkalinity	mg/L	3200	1100	2500	5400	4200	2200	820
Total Dissolved Solids	mg/L	12000	5000	4600	16000	11000	7900 J	5000 J
Total Organic Carbon	mg/L	57 J	47 J	65 J	100 J	87 J	110 J	26 J
Total Solids (Residue)	mg/L	12000	7200	5200	22000	11000	8100 J	5300 J

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		CMSMW-14S CMSMW-14S 25-Aug-99 Water Field Sample A9H270119002 13-Sep-99	CMSMW-39S CMSMW-39S 25-Aug-99 Water Field Sample A9H270119003 13-Sep-99	CMSMW-15 CMSMW-15 19-Aug-99 Water Field Sample A9H210120005 16-Sep-99	CMSMW-16F CMSMW-16F 24-Aug-99 Water Field Sample A9H260105007 13-Sep-99	CMSMW-18 CMSMW-18 24-Aug-99 Water Field Sample A9H260105004 13-Sep-99	RFIMW-1 RFIMW-1 19-Aug-99 Water Field Sample A9H210120006 16-Sep-99	RFIMW-4 RFIMW-4 20-Aug-99 Water Field Sample A9H240148004 16-Sep-99
Analyte	Units							
Non-regulated compounds								
Calcium	mg/L	550	551	1630	117	1020	573	463
Chemical Oxygen Demand (COD)	mg/L	97.4	101	373	2500	1600	261	84.8
Hardness, as CaCO ₃	mg/L	1700	1800	4300	450	3100	2200	1400
Total Alkalinity	mg/L	560	530	200	910	2400	630	700
Total Dissolved Solids	mg/L	2900	3000	740	5600	4500	30000	4100
Total Organic Carbon	mg/L	24 J	23 J	16 J	300 J	38 J	23 J	10 J
Total Solids (Residue)	mg/L	4400 J	3100 J	1400	6000	6200	31000 J	1800 R

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		RFIMW-5 RFIMW-5 20-Aug-99 Water Field Sample A9H240148005 16-Sep-99	RFIMW-30 RFIMW-30 20-Aug-99 Water Field Sample A9H240148006 16-Sep-99	RFIMW-6 RFIMW-6 23-Aug-99 Water Field Sample A9H250128003 13-Sep-99	RFIMW-7 RFIMW-7 23-Aug-99 Water Field Sample A9H250128006 13-Sep-99	RFIMW-13 RFIMW-13 19-Aug-99 Water Field Sample A9H210120008 16-Sep-99	RFIMW-14 RFIMW-14 20-Aug-99 Water Field Sample A9H240148002 16-Sep-99	RFIMW-39 RFIMW-39 20-Aug-99 Water Field Sample A9H240148003 16-Sep-99
Analyte	Units							
Non-regulated compounds								
Calcium	mg/L	3330	3290	640	881	482	2040	1850
Chemical Oxygen Demand (COD)	mg/L	69.9	71.5	30	118	61.4	117	100
Hardness, as CaCO ₃	mg/L	8400	8500	1500	2300	2000	7000	6800
Total Alkalinity	mg/L	880 J	79 J	540	1100	620	700	730
Total Dissolved Solids	mg/L	15000	15000	3000 J	13000 J	31000	77000	76000
Total Organic Carbon	mg/L	6 J	8 J	7	7 J	160 J	7 J	7 J
Total Solids (Residue)	mg/L	7500 R	16000	2900 J	13000 J	30000 J	77000	78000

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		RFIMW-22 RFIMW-22 19-Aug-99 Water Field Sample A9H210120004 16-Sep-99	RFIMW-23 RFIMW-23 19-Aug-99 Water Field Sample A9H210120002 16-Sep-99	RFIMW-29 RFIMW-29 23-Aug-99 Water Field Sample A9H250128001 13-Sep-99	PM4NA PM4NA 23-Aug-99 Water Field Sample A9H250128002 13-Sep-99
Analyte	Units				
Non-regulated compounds					
Calcium	mg/L	103	271	556	108
Chemical Oxygen Demand (COD)	mg/L	300	64.4	53.3	1470
Hardness, as CaCO ₃	mg/L	340	790	1100	1000
Total Alkalinity	mg/L	6200	150	430	8600
Total Dissolved Solids	mg/L	15000	3200	7300 J	43000 J
Total Organic Carbon	mg/L	740 J	10 J	5 J	360 J
Total Solids (Residue)	mg/L	5000 R	2600 R	7800 J	42000 J

**TABLE E.1
ANALYTICAL AIR DATA RESULTS**

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		BASF-1-1 BASF-1-1 12-Aug-99 Air Field Sample H9H160123 22-Aug-99	BASF-1-2 BASF-1-2 13-Aug-99 Air Field Sample H9H160124 30-Aug-99	BASF-1-3 BASF-1-3 16-Aug-99 Air Field Sample H9H170116 30-Aug-99	BASF-2-1 BASF-2-1 12-Aug-99 Air Field Sample H9H160123 22-Aug-99	BASF-2-2 BASF-2-2 13-Aug-99 Air Field Sample H9H160124 30-Aug-99	BASF-2-3 BASF-2-3 16-Aug-99 Air Field Sample H9H170116 30-Aug-99	BASF-3-1 BASF-3-1 12-Aug-99 Air Field Sample H9H160123 22-Aug-99	BASF-3-2 BASF-3-2 13-Aug-99 Air Field Sample H9H160124 30-Aug-99	BASF-3-3 BASF-3-3 16-Aug-99 Air Field Sample H9H170116 30-Aug-99
Analyte										
1,1,1-Trichloroethane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
1,1,2,2-Tetrachloroethane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
1,1,2-Trichloro-1,2,2-trifluoroethane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
1,1,2-Trichloroethane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
1,1-Dichloroethane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
1,1-Dichloroethene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
1,2,4-Trichlorobenzene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
1,2,4-Trimethylbenzene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.71	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
1,2-Dibromoethane (EDB)	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
1,2-Dichlorobenzene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
1,2-Dichloroethane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
1,2-Dichloropropane	ppb(v/v)	0.83 UJ	0.67 UJ	0.69 U	0.66 UJ	0.67 UJ	0.7 U	0.71 UJ	0.69 UJ	0.67 U
1,3,5-Trimethylbenzene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
1,3-Butadiene	ppb(v/v)	0.83 UJ	0.67 UJ	0.69 U	0.66 UJ	0.67 UJ	0.7 U	0.71 UJ	0.69 UJ	0.67 U
1,3-Dichlorobenzene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
1,4-Dichlorobenzene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.94
1-Butanol	ppb(v/v)	2.1 UJ	1.7 UJ	1.7 U	1.6 U	1.7 UJ	1.7 U	1.8 UJ	1.7 UJ	1.7 U
2-Butanone (MEK)	ppb(v/v)	2.1 U	1.7 UJ	1.7 U	1.6 U	1.7 UJ	1.7 U	1.8 U	1.7 UJ	1.7 U
2-Hexanone	ppb(v/v)	2.1 U	1.7 UJ	1.7 U	1.6 U	1.7 UJ	1.7 U	1.8 U	1.7 UJ	1.7 U
3-Chloropropene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
4-Methyl-2-pentanone (MIBK)	ppb(v/v)	2.1 UJ	1.7 UJ	1.7 U	3.5 J	1.7 UJ	1.7 U	1.8 UJ	1.7 UJ	2.3
Acetone	ppb(v/v)	21 U	17 UJ	17 U	16 U	17 UJ	17 U	18 U	17 UJ	17 U
Acetonitrile	ppb(v/v)	4.2 UJ	3.3 UJ	3.4 U	3.3 UJ	3.4 UJ	3.5 U	3.6 UJ	3.4 UJ	3.4 U
Acrolein	ppb(v/v)	2.1 U	1.7 UJ	1.7 U	1.8	1.7 UJ	1.7 U	1.8 U	1.7 UJ	1.7 U
Acrylonitrile	ppb(v/v)	2.1 U	1.7 UJ	1.7 U	1.6 U	1.7 UJ	1.7 U	1.8 U	1.7 UJ	1.7 U
alpha-Methylstyrene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Benzene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Benzyl chloride	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Bromodichloromethane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Bromoform	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Bromomethane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Carbon disulfide	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Carbon tetrachloride	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Chlorobenzene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Chlorodifluoromethane	ppb(v/v)	0.83 UJ	0.67 UJ	0.69 U	0.66 UJ	0.67 UJ	0.7 U	0.71 UJ	0.69 UJ	0.67 U
Chloroethane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Chloroform	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U

TABLE E.1
ANALYTICAL AIR DATA RESULTS

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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		BASF-1-1 BASF-1-1 12-Aug-99 Air Field Sample H9H160123 22-Aug-99	BASF-1-2 BASF-1-2 13-Aug-99 Air Field Sample H9H160124 30-Aug-99	BASF-1-3 BASF-1-3 16-Aug-99 Air Field Sample H9H170116 30-Aug-99	BASF-2-1 BASF-2-1 12-Aug-99 Air Field Sample H9H160123 - 22-Aug-99	BASF-2-2 BASF-2-2 13-Aug-99 Air Field Sample H9H160124 30-Aug-99	BASF-2-3 BASF-2-3 16-Aug-99 Air Field Sample H9H170116 30-Aug-99	BASF-3-1 BASF-3-1 12-Aug-99 Air Field Sample H9H160123 22-Aug-99	BASF-3-2 BASF-3-2 13-Aug-99 Air Field Sample H9H160124 30-Aug-99	BASF-3-3 BASF-3-3 16-Aug-99 Air Field Sample H9H170116 30-Aug-99
Analyte										
Chloromethane	ppb(v/v)	2.1 UJ	1.7 UJ	1.7 U	1.6 UJ	1.7 UJ	1.7 U	1.8 UJ	1.7 UJ	1.7 U
cis-1,2-Dichloroethene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
cis-1,3-Dichloropropene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Cumene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Cyclohexane	ppb(v/v)	2.1 UJ	1.7 UJ	1.7 U	1.6 UJ	1.7 UJ	1.7 U	1.8 UJ	1.7 UJ	1.7 U
Dibromochloromethane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Dibromomethane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Dichlorodifluoromethane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Ethyl ether	ppb(v/v)	2.1 U	1.7 UJ	1.7 U	1.6 U	1.7 UJ	1.7 U	1.8 U	1.7 UJ	1.7 U
Ethylbenzene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Hexachlorobutadiene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
m-Xylene & p-Xylene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Methanol	ppb(v/v)	42 UJ	33 UJ	34 U	33 UJ	34 UJ	35 U	36 UJ	34 UJ	34 U
Methyl tert-butyl ether	ppb(v/v)	2.1 UJ	1.7 UJ	1.7 U	1.6 UJ	1.7 UJ	1.7 U	1.8 UJ	1.7 UJ	1.7 U
Methylene chloride	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
n-Butane	ppb(v/v)	1.4 U*	0.67 UJ	0.69 U	4.6 U*	0.67 UJ	0.7 U	2 U*	0.69 UJ	0.67 U
n-Decane	ppb(v/v)	0.83 U	0.67 UJ	1.4 U*	5.5	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
n-Dodecane	ppb(v/v)	0.84 U*	0.67 UJ	1.8 U*	9.7	0.67 UJ	0.7 U	1.1 U*	0.69 UJ	0.67 U
n-Heptane	ppb(v/v)	0.83 UJ	0.67 UJ	0.69 U	1.1 J	0.67 UJ	0.7 U	0.71 UJ	0.69 UJ	0.67 U
n-Hexane	ppb(v/v)	0.83 UJ	0.67 UJ	0.69 U	0.66 UJ	0.67 UJ	0.7 U	0.71 UJ	0.69 UJ	0.67 U
n-Octane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
n-Propylbenzene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
n-Undecane	ppb(v/v)	0.91 U*	0.67 UJ	2.1 U*	11	0.67 UJ	0.7 U	1 U*	0.69 UJ	0.67 U
Naphthalene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Nonane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	1.6	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
o-Xylene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Pentane	ppb(v/v)	2.1 U	1.7 UJ	1.7 U	1.6 U	1.7 UJ	1.7 U	1.8 U	1.7 UJ	1.7 U
Styrene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Tetrachloroethene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Toluene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
trans-1,2-Dichloroethene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
trans-1,3-Dichloropropene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Trichloroethene	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Trichlorofluoromethane	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U
Vinyl acetate	ppb(v/v)	2.1 U	1.7 UJ	1.7 U	1.6 U	1.7 UJ	1.7 U	1.8 U	1.7 UJ	1.7 U
Vinyl chloride	ppb(v/v)	0.83 U	0.67 UJ	0.69 U	0.66 U	0.67 UJ	0.7 U	0.71 U	0.69 UJ	0.67 U

TABLE E.1
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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		BASF-4-3 BASF-4-3 16-Aug-99 Air Field Sample H9H170116 30-Aug-99	BASF-AMBIENT AMBIENT 12-Aug-99 Air Field Sample H9H160123 22-Aug-99	BASF-CARRIER AIR CARRIER AIR 13-Aug-99 Air H9H160124 30-Aug-99	BASF-TRIP BLANK TRIP BLANK 16-Aug-99 Air H9H170116 30-Aug-99
Analyte					
1,1,1-Trichloroethane	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
1,1,2,2-Tetrachloroethane	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
1,1,2-Trichloro-1,2,2-trifluoroethane	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
1,1,2-Trichloroethane	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
1,1-Dichloroethane	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
1,1-Dichloroethene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
1,2,4-Trichlorobenzene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
1,2,4-Trimethylbenzene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
1,2-Dibromoethane (EDB)	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
1,2-Dichloro-1,1,2,2-tetrafluoroethane	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
1,2-Dichlorobenzene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
1,2-Dichloroethane	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
1,2-Dichloropropane	ppb(v/v)	0.74 U	0.57 UJ	0.56 UJ	0.2 U
1,3,5-Trimethylbenzene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
1,3-Butadiene	ppb(v/v)	0.74 U	0.57 UJ	0.56 UJ	0.2 U
1,3-Dichlorobenzene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
1,4-Dichlorobenzene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
1-Butanol	ppb(v/v)	1.9 U	1.4 UJ	1.4 UJ	0.5 U
2-Butanone (MEK)	ppb(v/v)	1.9 U	1.4 U	1.4 UJ	0.5 U
2-Hexanone	ppb(v/v)	1.9 U	1.4 U	1.4 UJ	0.5 U
3-Chloropropene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
4-Methyl-2-pentanone (MIBK)	ppb(v/v)	1.9 U	1.4 UJ	1.4 UJ	0.5 U
Acetone	ppb(v/v)	19 U	14 U	14 UJ	5 U
Acetonitrile	ppb(v/v)	3.7 U	2.9 UJ	2.8 UJ	1 U
Acrolein	ppb(v/v)	1.9 U	1.4 U	1.4 UJ	0.5 U
Acrylonitrile	ppb(v/v)	1.9 U	1.4 U	1.4 UJ	0.5 U
alpha-Methylstyrene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Benzene	ppb(v/v)	0.74 U	0.62	0.56 UJ	0.2 U
Benzyl chloride	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Bromodichloromethane	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Bromoform	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Bromomethane	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Carbon disulfide	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Carbon tetrachloride	ppb(v/v)	1.2	0.57 U	0.56 UJ	0.2 U
Chlorobenzene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Chlorodifluoromethane	ppb(v/v)	0.74 U	0.57 UJ	0.56 UJ	0.2 U
Chloroethane	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Chloroform	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U

**TABLE E.1
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Field Sample ID: Location Sample Date Matrix Sample Type Lab Sample ID Analysis Date		BASF-4-3 BASF-4-3 16-Aug-99 Air Field Sample H9H170116 30-Aug-99	BASF-AMBIENT AMBIENT 12-Aug-99 Air Field Sample H9H160123 22-Aug-99	BASF-CARRIER AIR CARRIER AIR 13-Aug-99 Air H9H160124 30-Aug-99	BASF-TRIP BLANK TRIP BLANK 16-Aug-99 Air H9H170116 30-Aug-99
Analyte					
Chloromethane	ppb(v/v)	1.9 U	1.4 UJ	1.4 UJ	0.5 U
cis-1,2-Dichloroethene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
cis-1,3-Dichloropropene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Cumene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Cyclohexane	ppb(v/v)	1.9 U	1.4 UJ	1.4 UJ	0.5 U
Dibromochloromethane	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Dibromomethane	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Dichlorodifluoromethane	ppb(v/v)	0.74 U	0.62	0.56 UJ	0.2 U
Ethyl ether	ppb(v/v)	1.9 U	1.4 U	1.4 UJ	0.5 U
Ethylbenzene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Hexachlorobutadiene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
m-Xylene & p-Xylene	ppb(v/v)	0.74 U	0.79	0.56 UJ	0.2 U
Methanol	ppb(v/v)	37 U	29 UJ	28 UJ	10 U
Methyl tert-butyl ether	ppb(v/v)	1.9 U	1.4 UJ	1.4 UJ	0.5 U
Methylene chloride	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
n-Butane	ppb(v/v)	0.74 U	2.5 J	0.56 UJ	0.2 U
n-Decane	ppb(v/v)	0.74 U	0.57 U	0.88 J	0.2 U
n-Dodecane	ppb(v/v)	0.74 U	0.57 U	0.61 J	0.2 U
n-Heptane	ppb(v/v)	0.74 U	0.57 UJ	0.56 UJ	0.2 U
n-Hexane	ppb(v/v)	0.74 U	0.57 UJ	0.56 UJ	0.2 U
n-Octane	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
n-Propylbenzene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
n-Undecane	ppb(v/v)	0.74 U	0.57 U	1.4 J	0.2 U
Naphthalene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Nonane	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
o-Xylene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Pentane	ppb(v/v)	1.9 U	1.8	1.4 UJ	0.5 U
Styrene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Tetrachloroethene	ppb(v/v)	1.9	0.57 U	0.56 UJ	0.2 U
Toluene	ppb(v/v)	0.74 U	1.8	0.56 UJ	0.2 U
trans-1,2-Dichloroethene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
trans-1,3-Dichloropropene	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Trichloroethene	ppb(v/v)	3.6	0.57 U	0.56 UJ	0.2 U
Trichlorofluoromethane	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U
Vinyl acetate	ppb(v/v)	1.9 U	1.4 U	1.4 UJ	0.5 U
Vinyl chloride	ppb(v/v)	0.74 U	0.57 U	0.56 UJ	0.2 U



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ANALYTICAL REPORT

PROJECT NO. 733893

BASF WYANDOTTE

Lot #: A9H120186

Mona Sutherland

Parsons Engineering Science, I

QUANTERRA INCORPORATED

A large, stylized handwritten signature in black ink, appearing to read 'Alesia M. Danford', is written over the printed name and title.

Alesia M. Danford
Project Manager

September 3, 1999

CASE NARRATIVE

The following report contains the analytical results for forty-three solid samples submitted to Quanterra-North Canton by Parsons Engineering Science, Inc. from the BASF-Wyandotte Site, project number 733893. The samples were received August 12, 1999, according to documented sample acceptance procedures.

Samples were subcontracted to Applied Construction Technologies, Inc. for Grain Size analyses. These results are presented in this report.

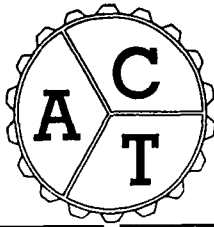
Quanterra-North Canton utilizes USEPA approved methods in all analytical work. The samples presented in this report were analyzed for the parameter listed on the analytical methods summary page in accordance with the methods indicated.

The results included in this report have been reviewed for compliance with the laboratory QA/QC plan. All data have been found to be compliant with laboratory protocol.

SAMPLE SUMMARY

The analytical results of the samples listed below are presented
on the following pages.

WO #	LABORATORY ID	SAMPLE IDENTIFICATION	DATE/TIME	SAMPLED
D193T	A9H120186-001	CMSMW-1-1'-3'	8/04/99	9:45
D1944	A9H120186-002	CMSMW-1-5'-8'	8/04/99	9:45
D1945	A9H120186-003	CMSMW-1-8'-11'	8/04/99	9:45
D1948	A9H120186-004	CMSMW-1-11'-12'	8/04/99	9:45
D194A	A9H120186-005	CMSMW-2-0'-2'	8/04/99	12:30
D194E	A9H120186-006	CMSMW-2-4'-6'	8/04/99	12:30
D194G	A9H120186-007	CMSMW-3-2'-4'	8/04/99	14:00
D194L	A9H120186-008	CMSMW-3-5'-6'	8/04/99	14:00
D194R	A9H120186-009	CMSMW-15-2'-4'	8/05/99	9:00
D194X	A9H120186-010	CMSMW-15-4'-5'	8/05/99	9:00
D1952	A9H120186-011	CMSMW-15-5'-6'	8/05/99	9:00
D1953	A9H120186-012	CMSMW-15-9'-10'	8/05/99	9:00
D195A	A9H120186-013	CMSMW-4-1'-2'	8/05/99	11:20
D195D	A9H120186-014	CMSMW-4-9.5'-11.5'	8/05/99	11:20
D195G	A9H120186-015	CMSMW-4-13.5'-15.5'	8/05/99	11:20
D195L	A9H120186-016	CMSMW-5-1'-3'	8/05/99	16:20
D195R	A9H120186-017	CMSMW-5-4'-6'	8/05/99	16:20
195T	A9H120186-018	CMSMW-5-6'-8'	8/05/99	16:20
D195X	A9H120186-019	CMSMW-5-7'-8'	8/05/99	16:20
D1962	A9H120186-020	CMSMW-5-15'-15.5'	8/05/99	16:20
D1969	A9H120186-021	CMSMW-5-15.5'-16'	8/05/99	16:20
D196E	A9H120186-022	CMSMW-6-2'-4'	8/09/99	12:15
D196H	A9H120186-023	CMSMW-6-5'-6'	8/09/99	12:15
D196K	A9H120186-024	CMSMW-6-8'-10'	8/09/99	12:15
D196M	A9H120186-025	CMSMW-6-15'-16'	8/09/99	12:15
D196P	A9H120186-026	CMSMW-6-19'-19.2'	8/09/99	12:15
D196W	A9H120186-027	CMSMW-6-19.2'-20'	8/09/99	12:15
D1971	A9H120186-028	CMSMW-7-1'-2'	8/10/99	11:00
D1975	A9H120186-029	CMSMW-7-10'-12'	8/10/99	11:00
D1978	A9H120186-030	CMSMW-7-12'-14'	8/10/99	11:00
D197D	A9H120186-031	CMSMW-8-1'-2'	8/10/99	15:10
D197G	A9H120186-032	CMSMW-8-8'-9.8'	8/10/99	15:10
D197L	A9H120186-033	CMSMW-8-10'-12'	8/10/99	15:10
D197P	A9H120186-034	CMSMW-10-3'-5'	8/11/99	11:10
D197Q	A9H120186-035	CMSMW-10-7'-8'	8/11/99	11:10
D197R	A9H120186-036	CMSMW-10-5'-6'	8/11/99	11:10
D197T	A9H120186-037	CMSMW-10-8'-9.5'	8/11/99	11:10
D197W	A9H120186-038	CMSMW-10-10'-12'	8/11/99	11:10
D197X	A9H120186-039	CMSMW-11-6'-1.8'	8/11/99	14:15
D1980	A9H120186-040	CMSMW-11-2'-4'	8/11/99	14:15
D1984	A9H120186-041	CMSMW-11-7.5'-8'	8/11/99	14:15
D1985	A9H120186-042	CMSMW-11-12'-14'	8/11/99	14:15
71986	A9H120186-043	CMSMW-11-16'-18'	8/11/99	14:15



ENGINEERING • TESTING • INSPECTION

APPLIED CONSTRUCTION TECHNOLOGIES, INC.

210 HAYES DRIVE • SUITE C • CLEVELAND, OHIO 44131 • (216) 459-TEST • FAX (216) 459-8954
478 E. EXCHANGE ST. • SUITE 202 • AKRON, OHIO 44304 • (330) 253-TEST • FAX (330) 253-3462

August 30, 1999

Quanterra, Inc.
4101 Shuffel Drive
North Canton, Ohio 44720

Attention: Ms. Alesia Danford

SUBJECT: LAB TEST RESULTS
FORTY-THREE SUBMITTED SOIL SAMPLES
CLIENT CODE: 2508
LAB P.O. SR017646

ACT PROJECT NO. 9901.16
Report No. 20 – 30 August 1999

Enclosed are grain size results for forty-three jar samples of soil and mixtures of soils and various materials submitted to ACT on August 13, 1999, and tested per procedures listed in ASTM D-422. Hydrometer analyses, where noted, were performed for most of the samples tested.

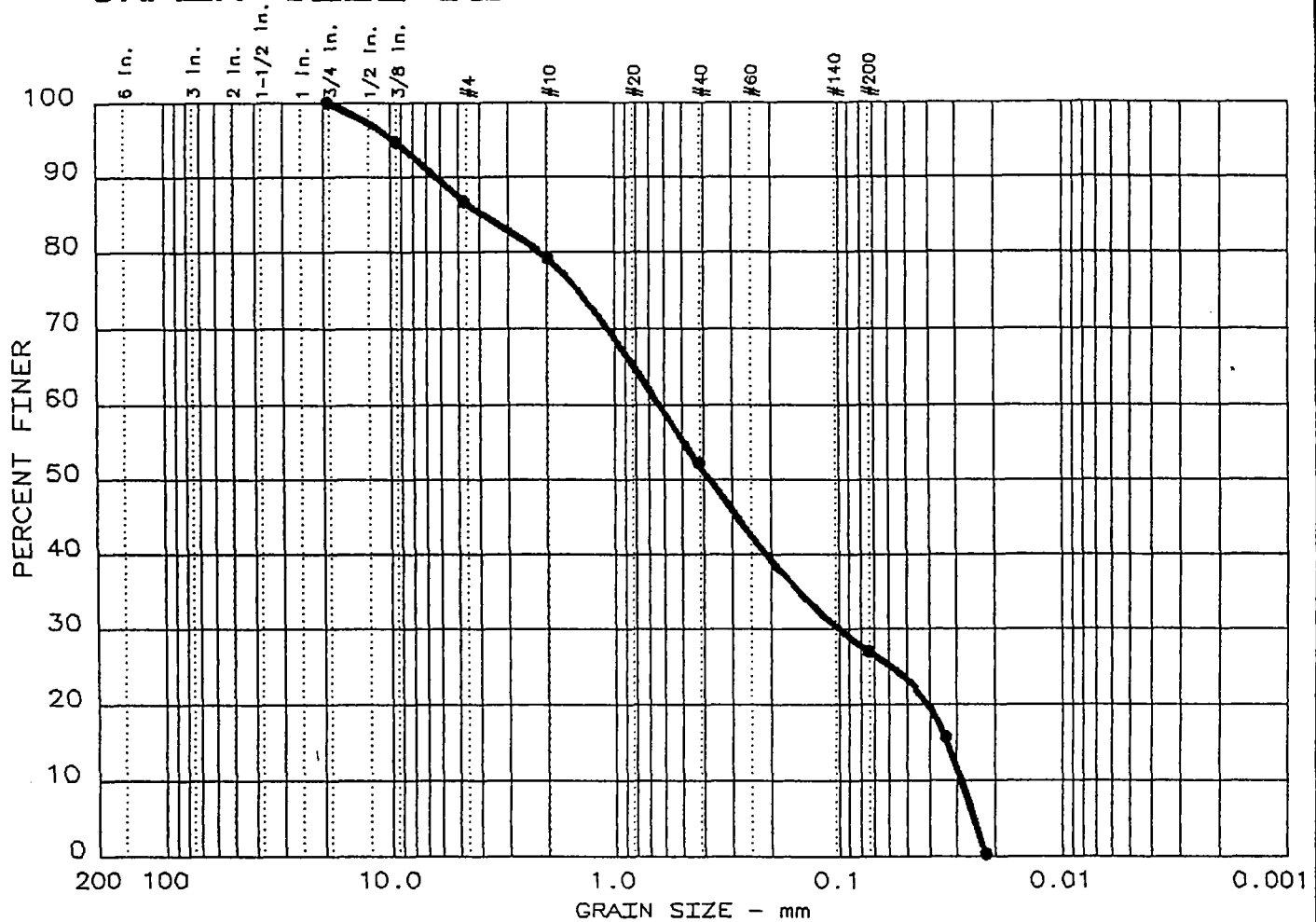
APPLIED CONSTRUCTION TECHNOLOGIES, INC.
Lab Technicians: Dawn Imbordino, Jason Lin, Cindy Ours
Leonard Wietrzykowski,
by:



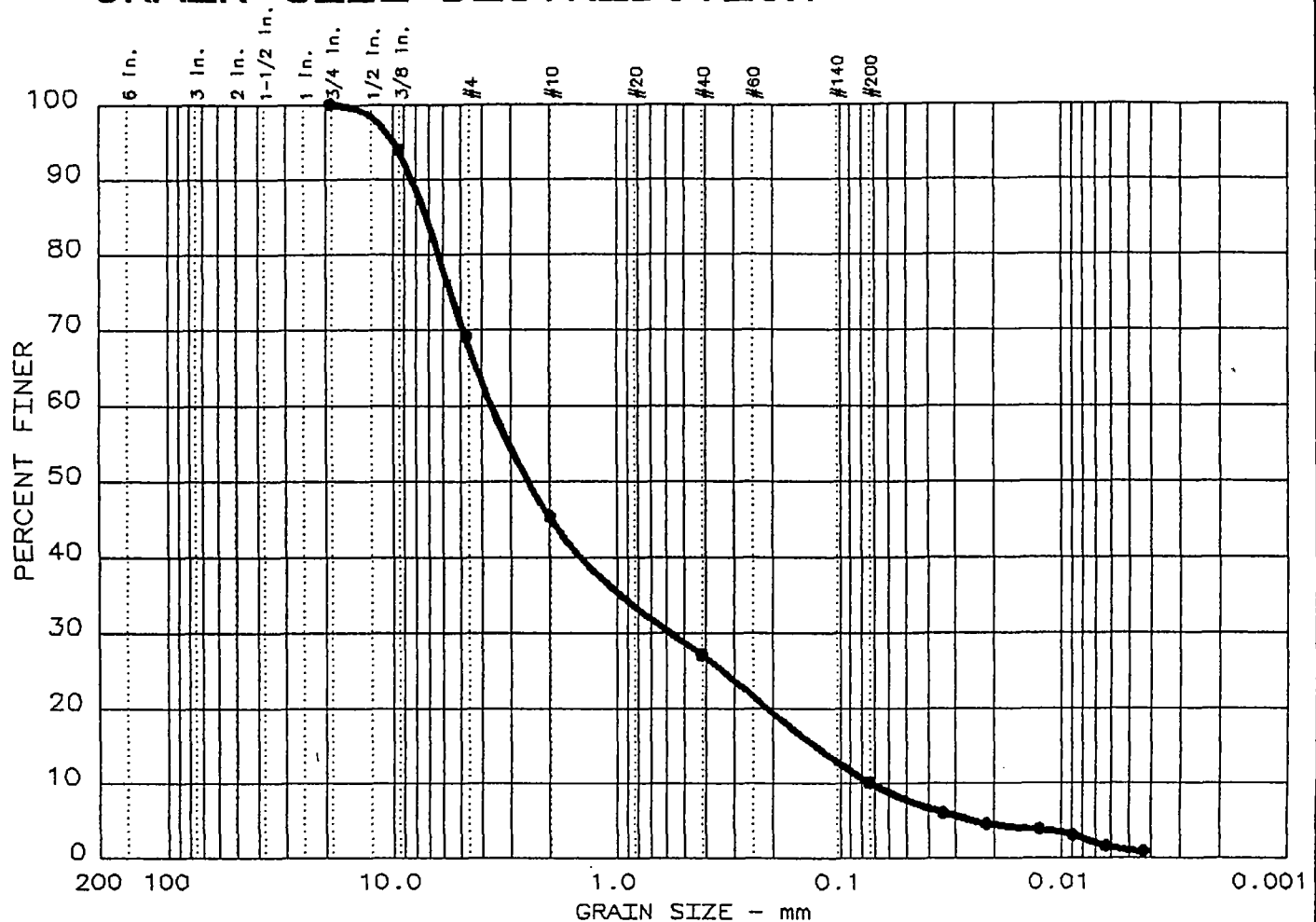
GEORGE WOZNIAK, C.E.T.
Manager – Materials Laboratory

GW:jh

GRAIN SIZE DISTRIBUTION TEST REPORT



GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	30.9	59.1	8.9	1.1

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		7.15	3.63	2.48	0.575	0.1302	0.0732	1.24	49.5

MATERIAL DESCRIPTION	USCS	AASHTO
● BLACK COAL AND CINDERS WITH INORGANIC FIBERS		

Project No.:
 Project: SR017646
 ● Location: A9H120186-002 D1944-1-01

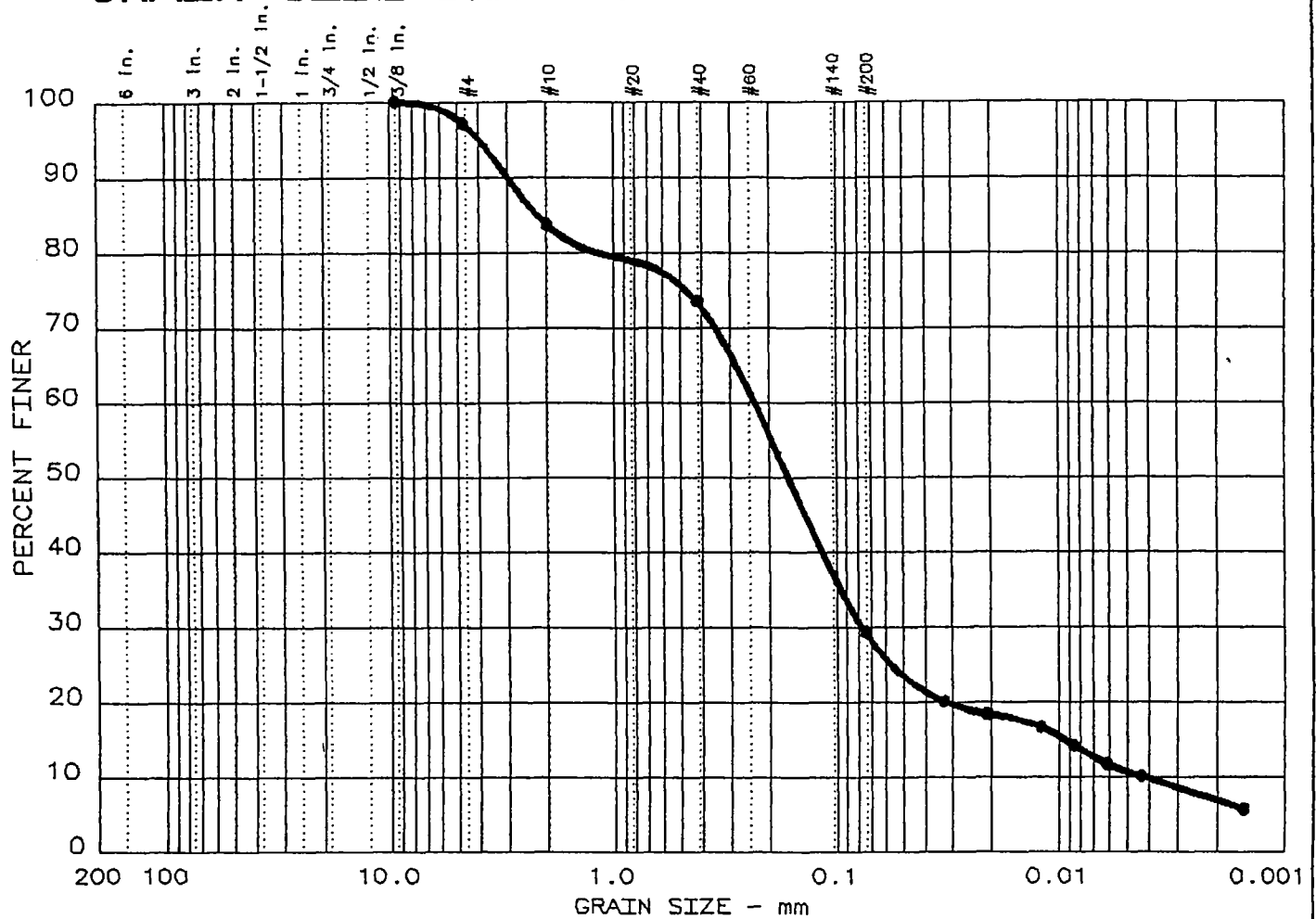
Date: 8/27/99

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 CLIENT: QUANTERRA, INC.
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 8-13-99

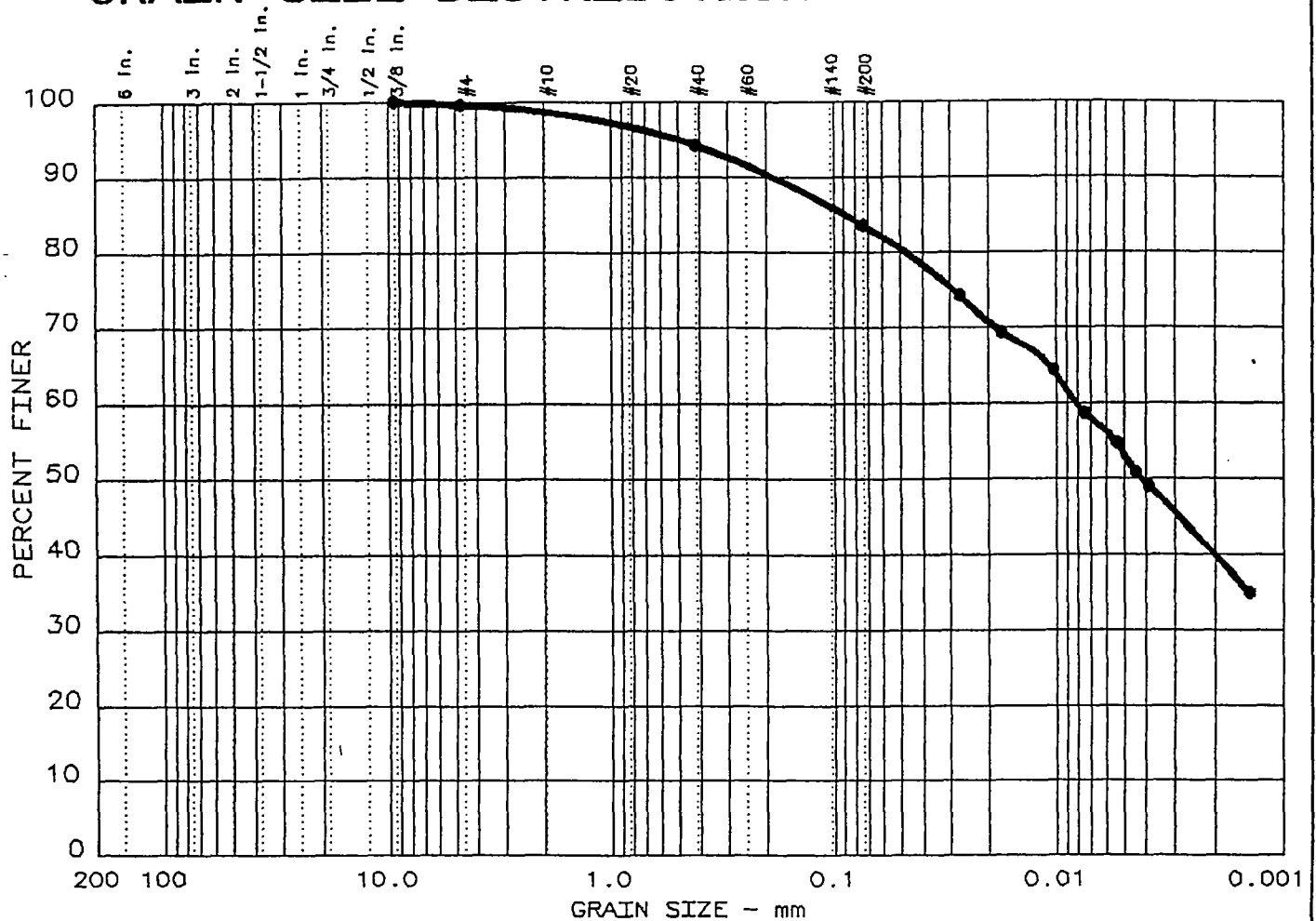
GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Figure No. 35

GRAIN SIZE DISTRIBUTION TEST REPORT



GRAIN SIZE DISTRIBUTION TEST REPORT

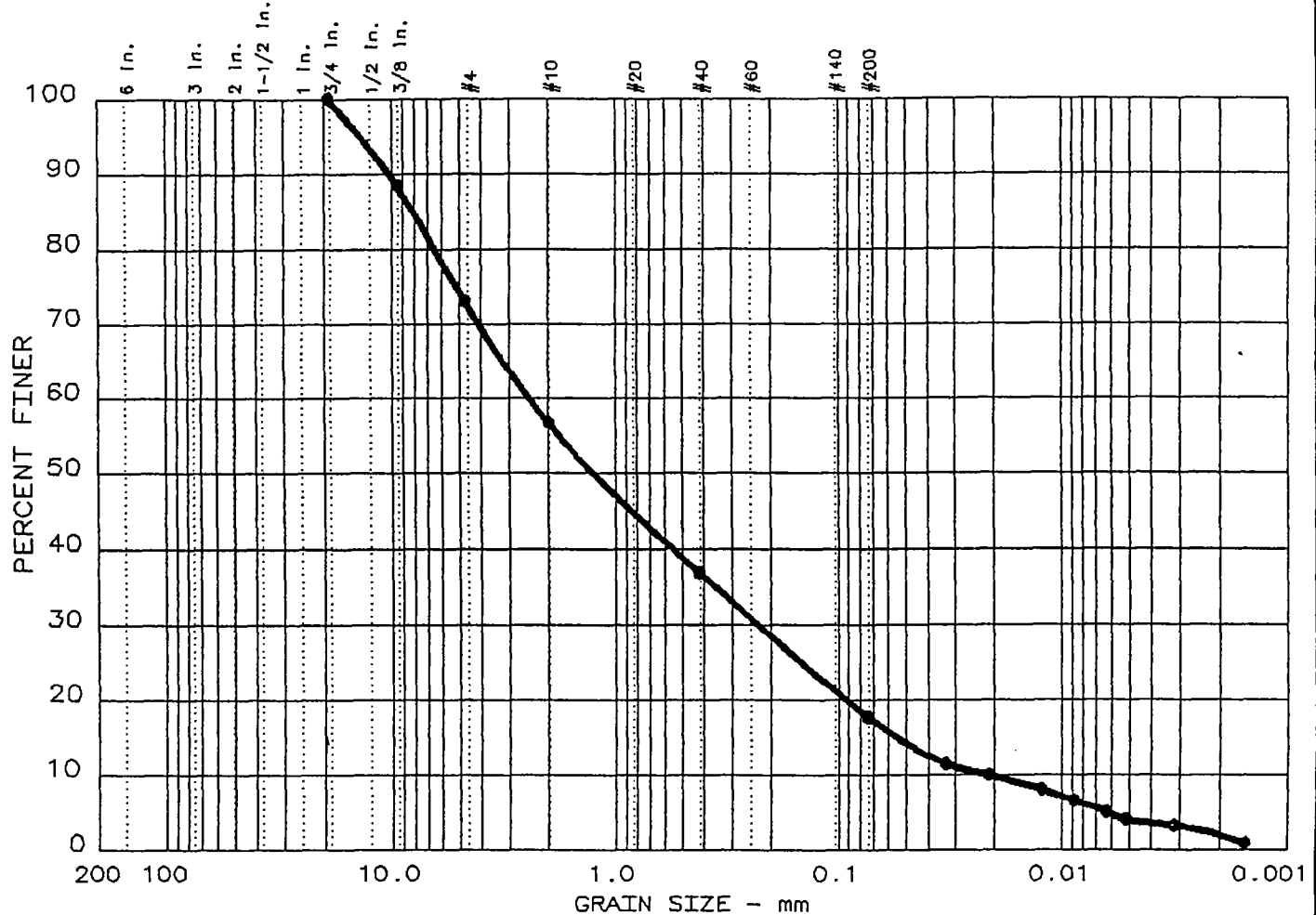


% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.4	16.1	30.3	53.2

[illegible]

MATERIAL DESCRIPTION		USCS	AASHTO
● BROWN & GRAY CLAY TRACE CINDERS, SHALE FRAGMENTS			
Project No.: Project: SR017646 ● Location: A9H120186-004 D1948-1-01 Date: 8/27/99		Remarks: CLIENT: QUANTERRA, INC. JAR SAMPLES RECEIVED ON 8-13-99 Figure No. 37	
GRAIN SIZE DISTRIBUTION TEST REPORT APPLIED CONSTRUCTION TECH., INC.			

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	26.9	55.4	13.8	3.9

[illegible]

MATERIAL DESCRIPTION	USCS	AASHTO
● BLACKISH SILTY SAND w/ CINDERS & LIMESTONE AGGR	SM	

Project No.:
Project: SR017646
● Location: A9H120186-005 D194A-1-01

Date: 8/27/99

GRAIN SIZE DISTRIBUTION TEST REPORT

APPLIED CONSTRUCTION TECH., INC.

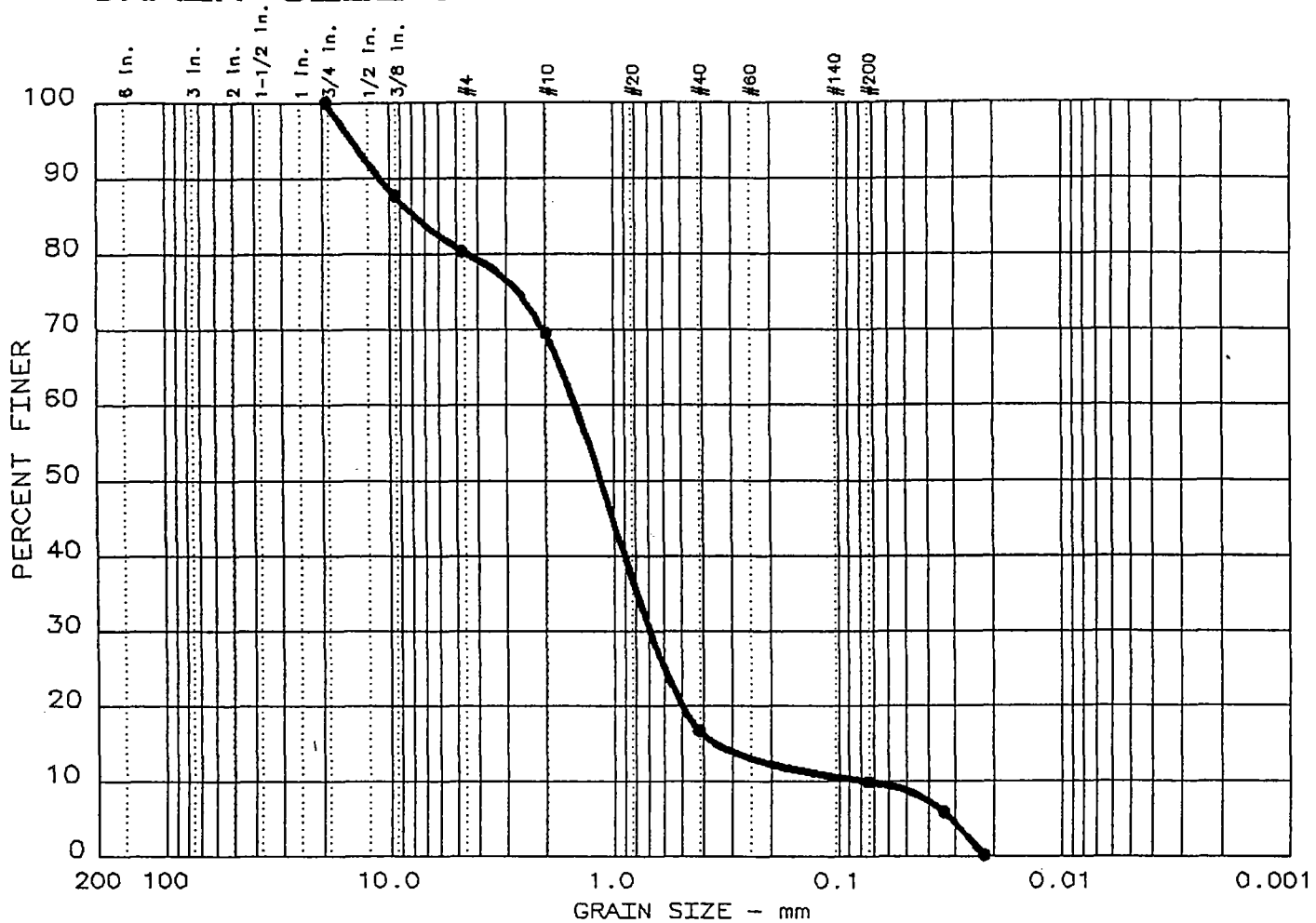
Remarks:

CLIENT: QUANTERRA, INC.
JAR SAMPLES RECEIVED ON
8-13-99

Figure No. 38

2 (4-6)

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	19.7	70.4	9.9	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		7.76	1.47	1.14	0.685	0.3597	0.0769	4.15	19.1

MATERIAL DESCRIPTION	USCS	AASHTO
● CRUSHED WHITE CHALKY MATERIAL.		

Project No.:
 Project: SR017646
 ● Location: A9H120186-006 D194E-1-01

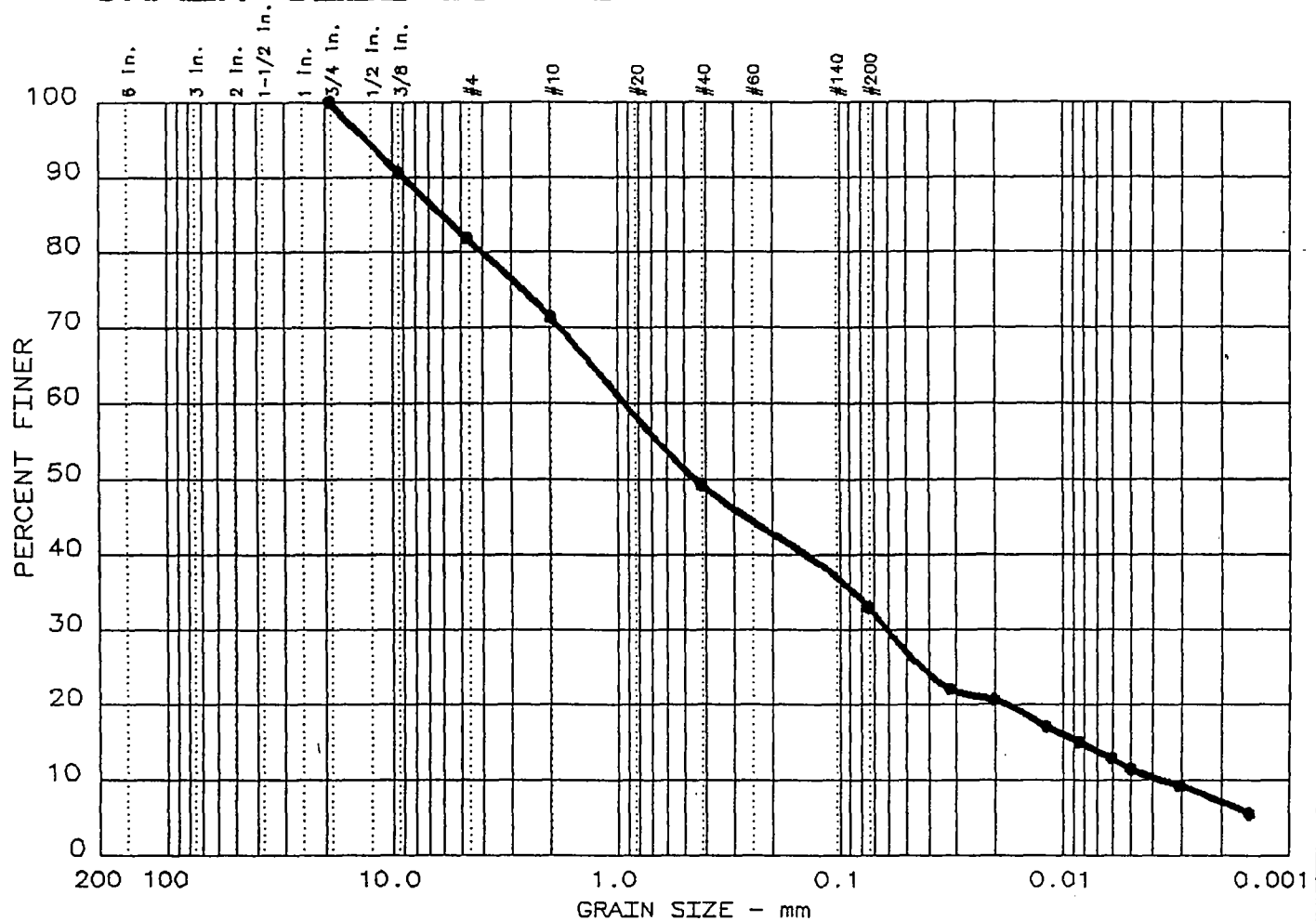
Date: 8/27/99

GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:
 CLIENT: QUANTERRA, INC.
 JAR SAMPLES RECEIVED ON
 8-13-99

Figure No. 39

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	18.2	48.9	21.4	11.5

[illegible]

MATERIAL DESCRIPTION	USCS	AASHTO
• DARK GRAY SILTY SAND w/ CINDERS & GRAVEL	SM	

Project No.:

Project: SR017646

- Location: A9H120186-007 D194G-1-01

Date: 8/27/99

GRAIN SIZE DISTRIBUTION TEST REPORT

APPLIED CONSTRUCTION TECH., INC.

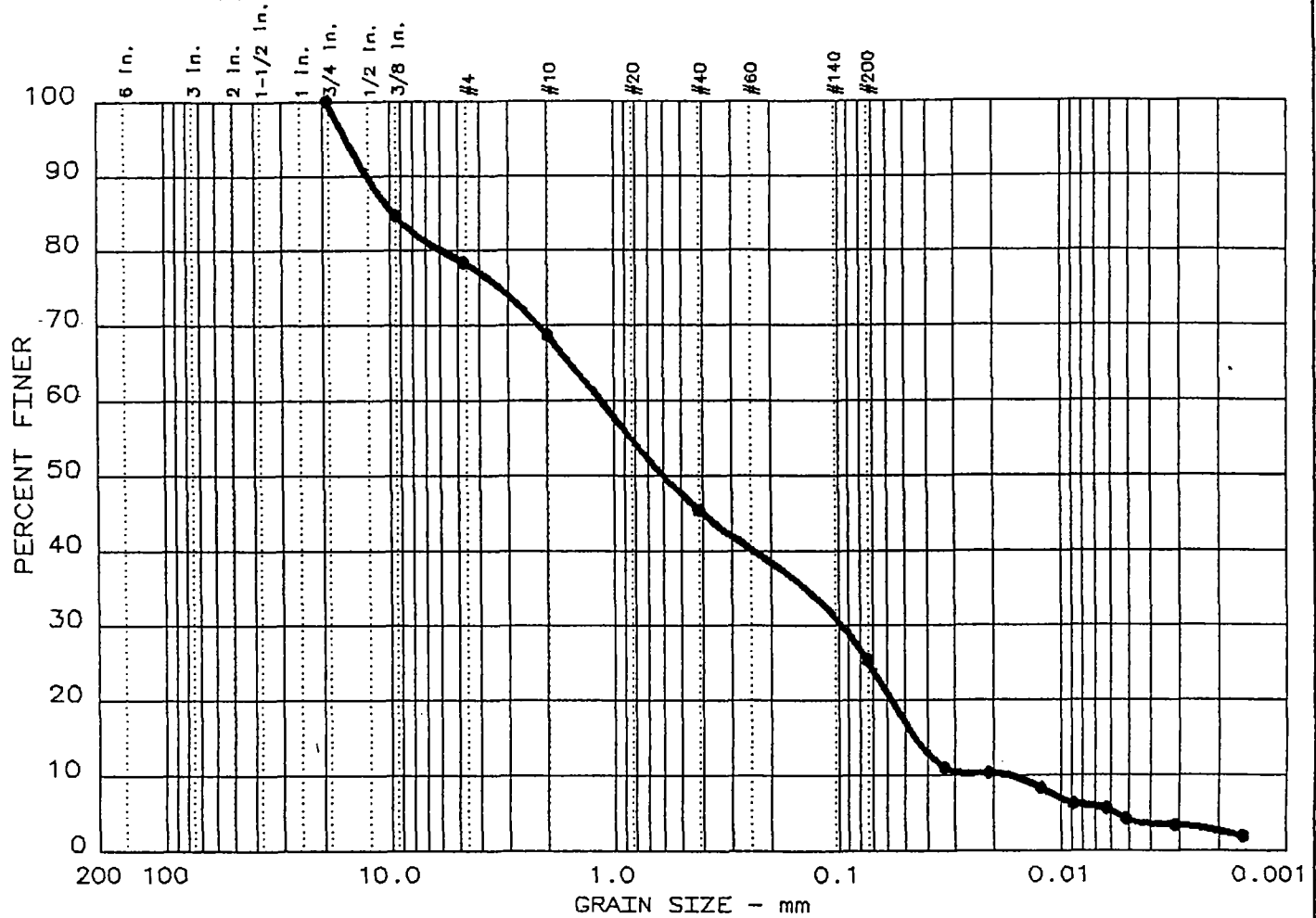
Remarks:

CLIENT: QUANTERRA, INC.

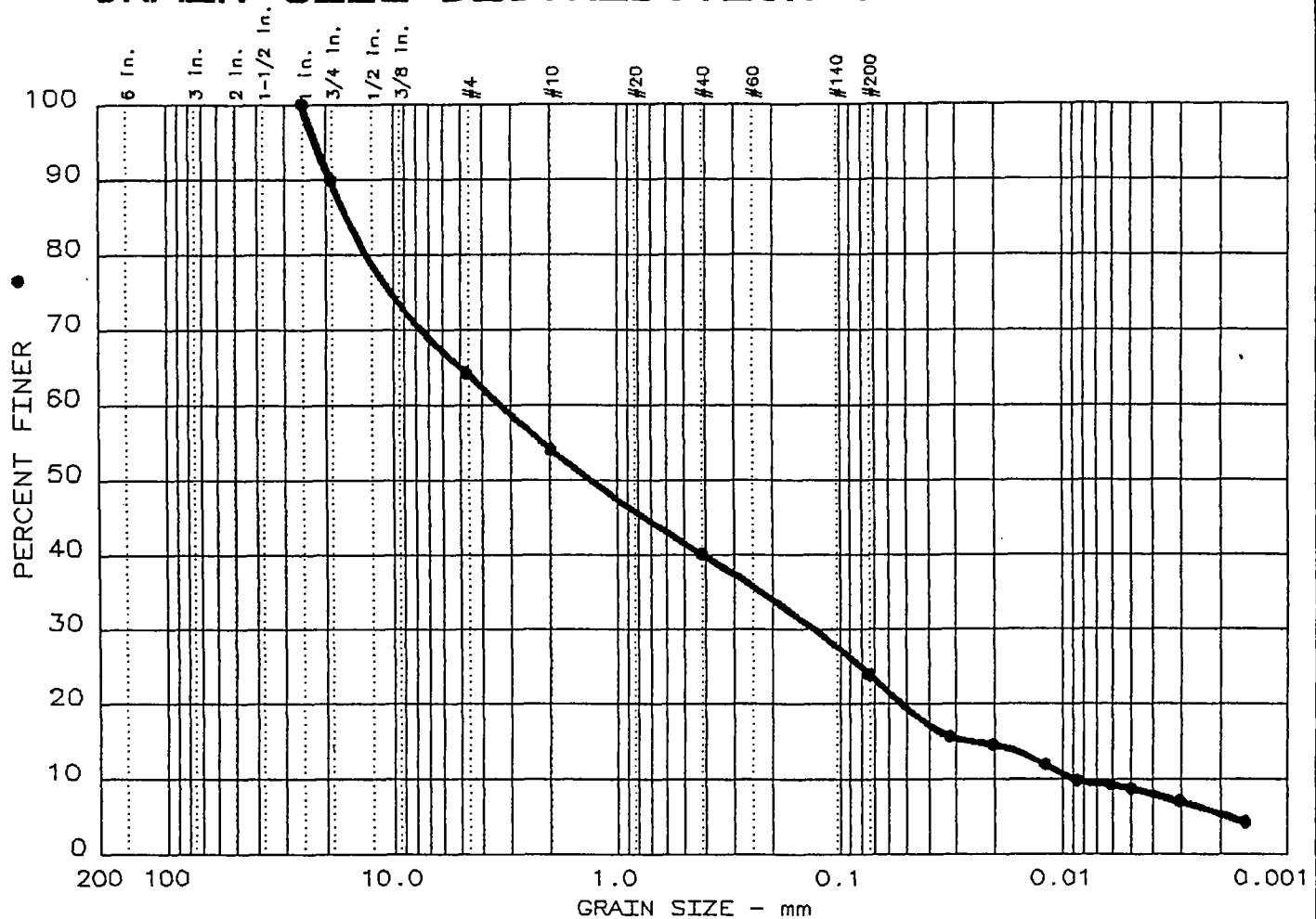
JAR SAMPLES RECEIVED ON
8-13-99

Figure No. 40

GRAIN SIZE DISTRIBUTION TEST REPORT



GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	35.8	40.3	15.2	8.7

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		16.16	3.34	1.33	0.130	0.0256	0.0090	0.56	371.5

MATERIAL DESCRIPTION	USCS	AASHTO
● DARK GRAY GRAVELLY SILTY SAND, w/ CINDERS.	SM	

Project No.:
 Project: SR017646
 ● Location: A9H120186-009 D194R-1-01

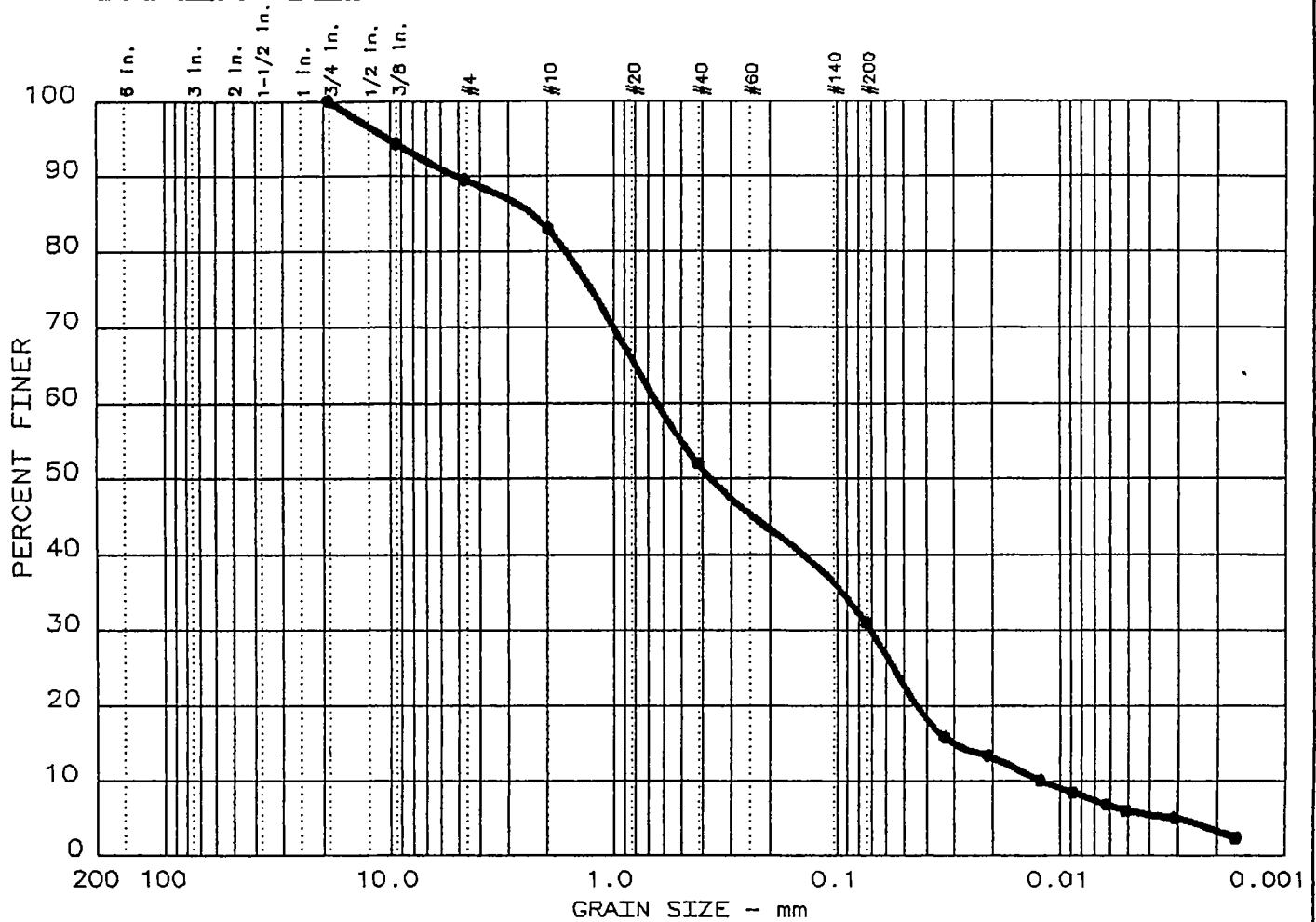
Date: 8/27/99

Remarks:
 CLIENT: QUANTERRA, INC.
 JAR SAMPLES RECEIVED ON
 8-13-99

GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Figure No. 42

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	10.6	58.4	25.1	5.9

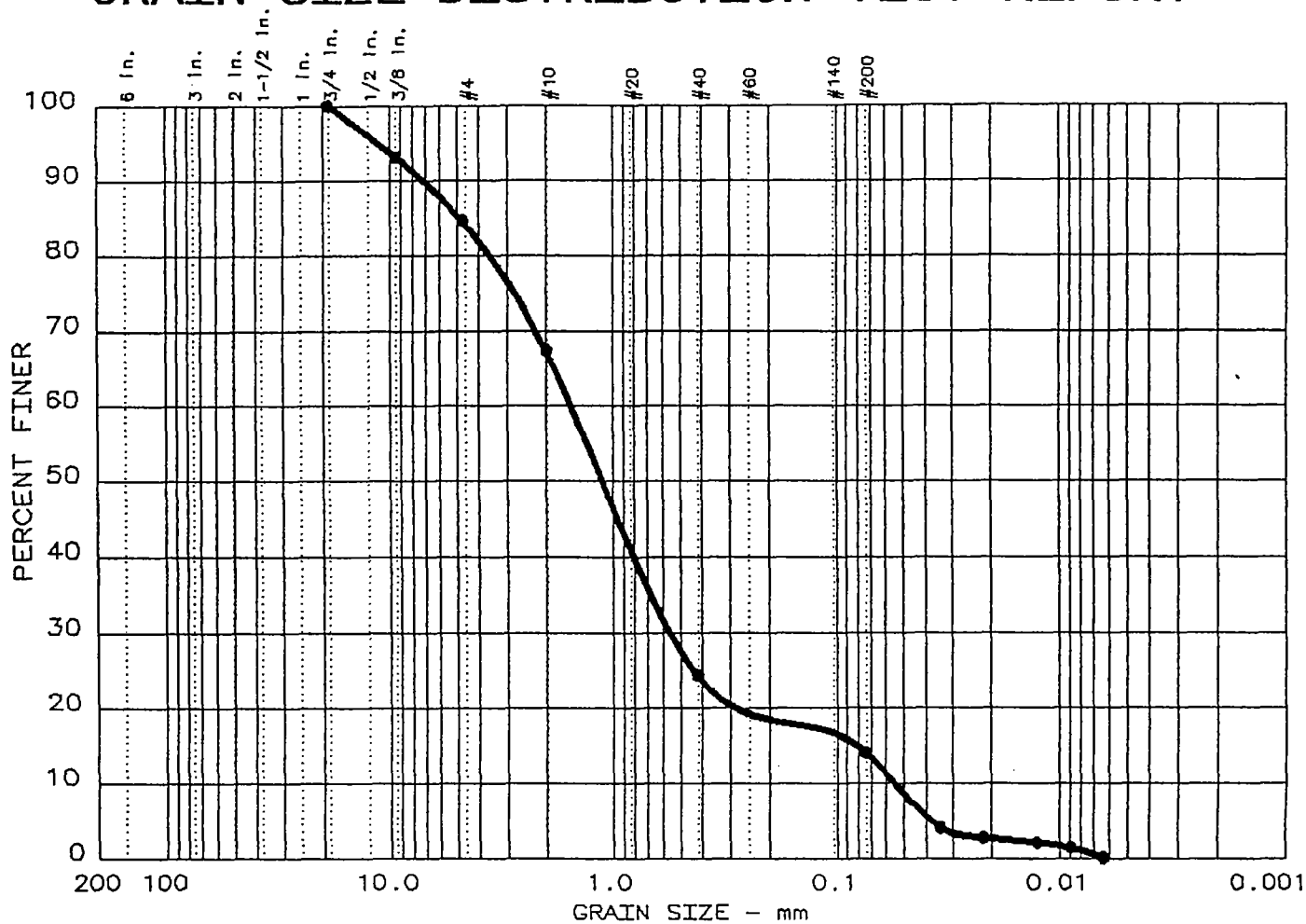
LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		2.37	0.63	0.37	0.070	0.0295	0.0122	0.64	51.9

MATERIAL DESCRIPTION	USCS	AASHTO
BROWN SILTY SAND, LITTLE CINDRES	SM	

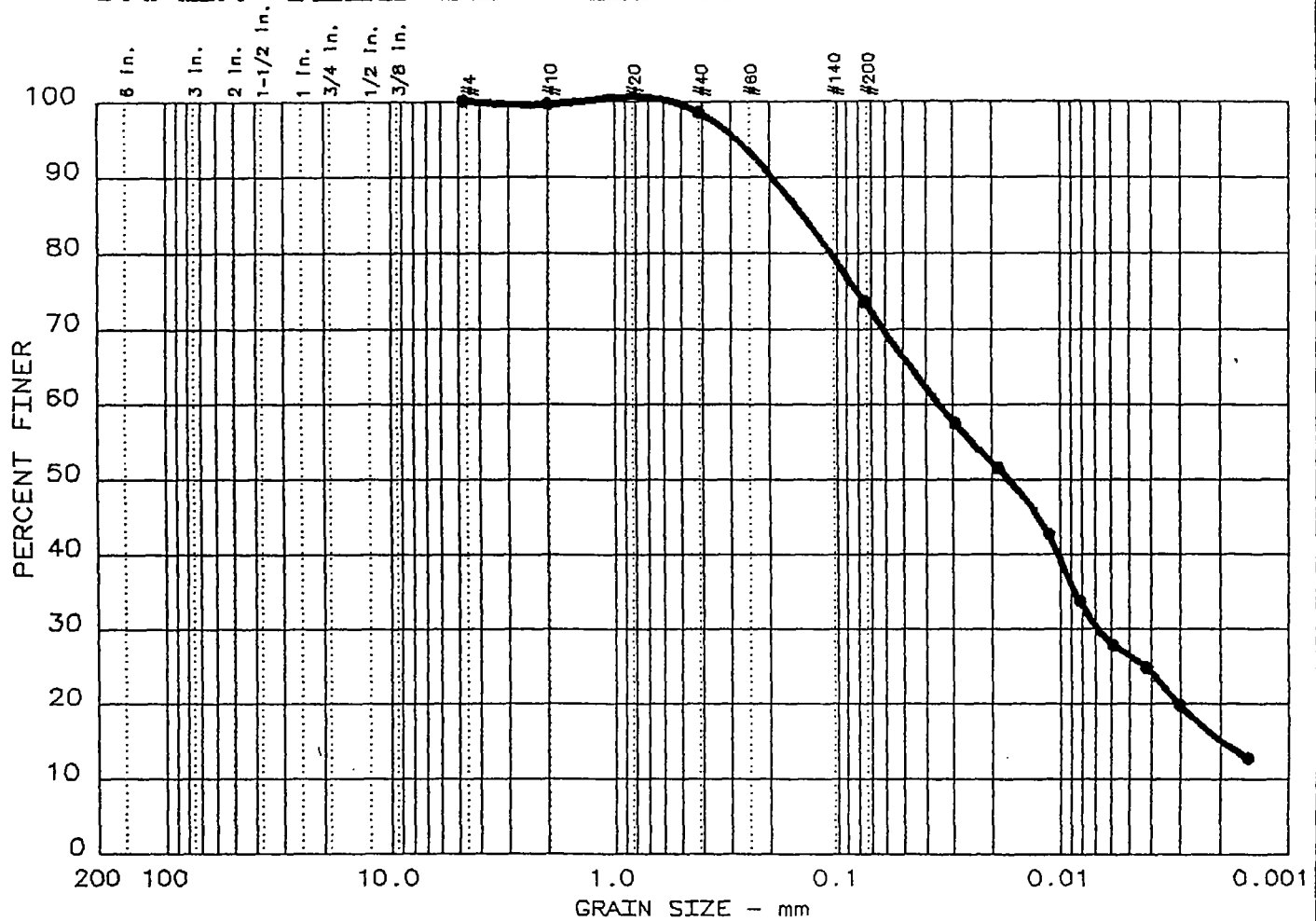
Project No.:
 Project: SR017646
 Location: A9H120186-010 D194X-1-01
 Date: 8/27/99

Remarks:
 CLIENT: QUANTERRA, INC.
 JAR SAMPLES RECEIVED ON
 8-13-99

GRAIN SIZE DISTRIBUTION TEST REPORT



GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	26.6	47.0	26.4

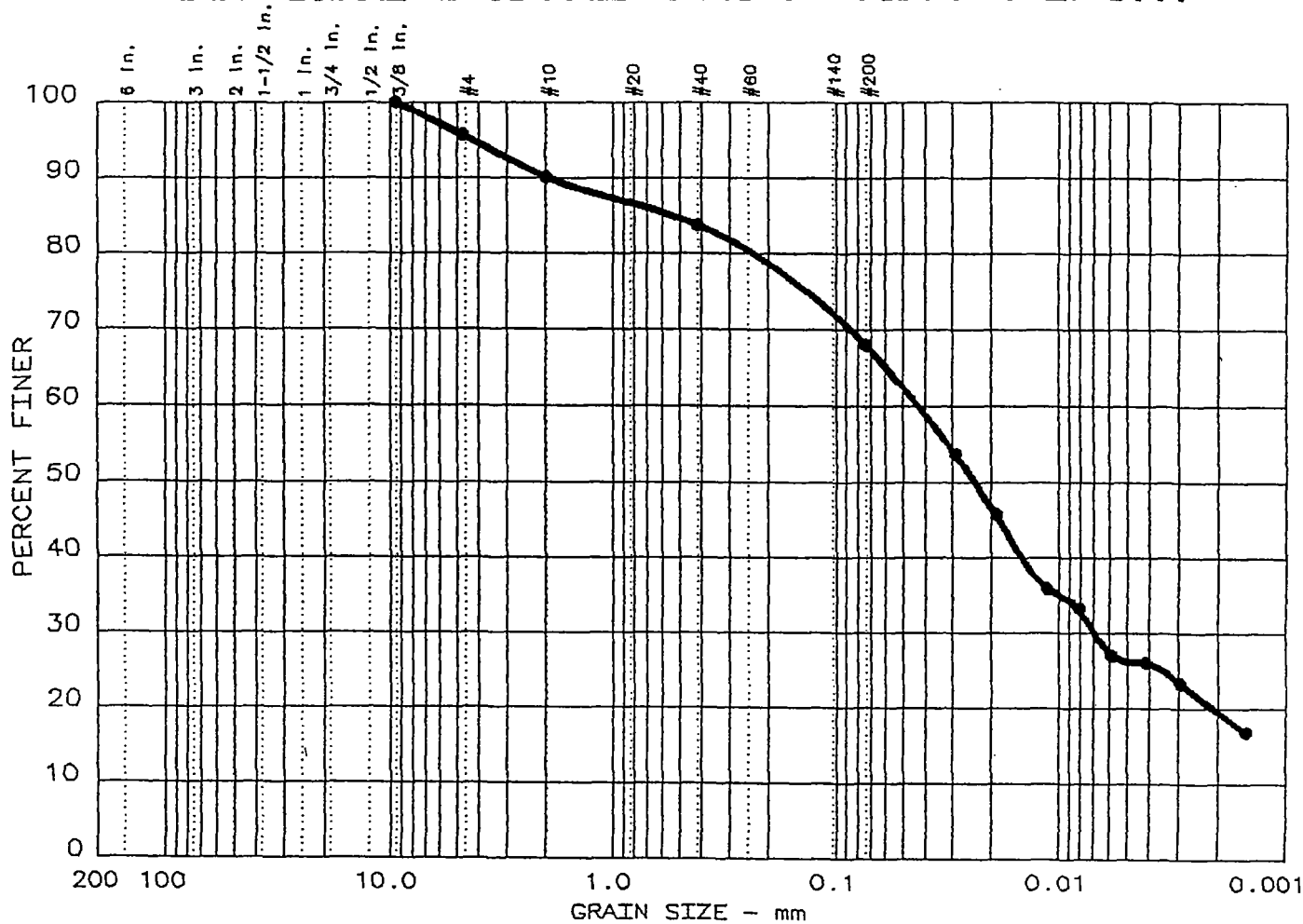
LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		0.14		0.02	0.007	0.0020			

MATERIAL DESCRIPTION	USCS	AASHTO
● BLACK LEAN CLAY WITH SAND, AND ORGANICS	CL	

Project No.: Project: SR017646 ● Location: A9H120186-012 D1953-1-01 Date: 8/26/99	Remarks: CLIENT: QUANTERRA, INC. JAR SAMPLES RECEIVED ON 8-13-99
GRAIN SIZE DISTRIBUTION TEST REPORT APPLIED CONSTRUCTION TECH., INC.	Figure No. 02

4(1-2)

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	4.4	27.7	41.8	26.1

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		0.55		0.02	0.007				

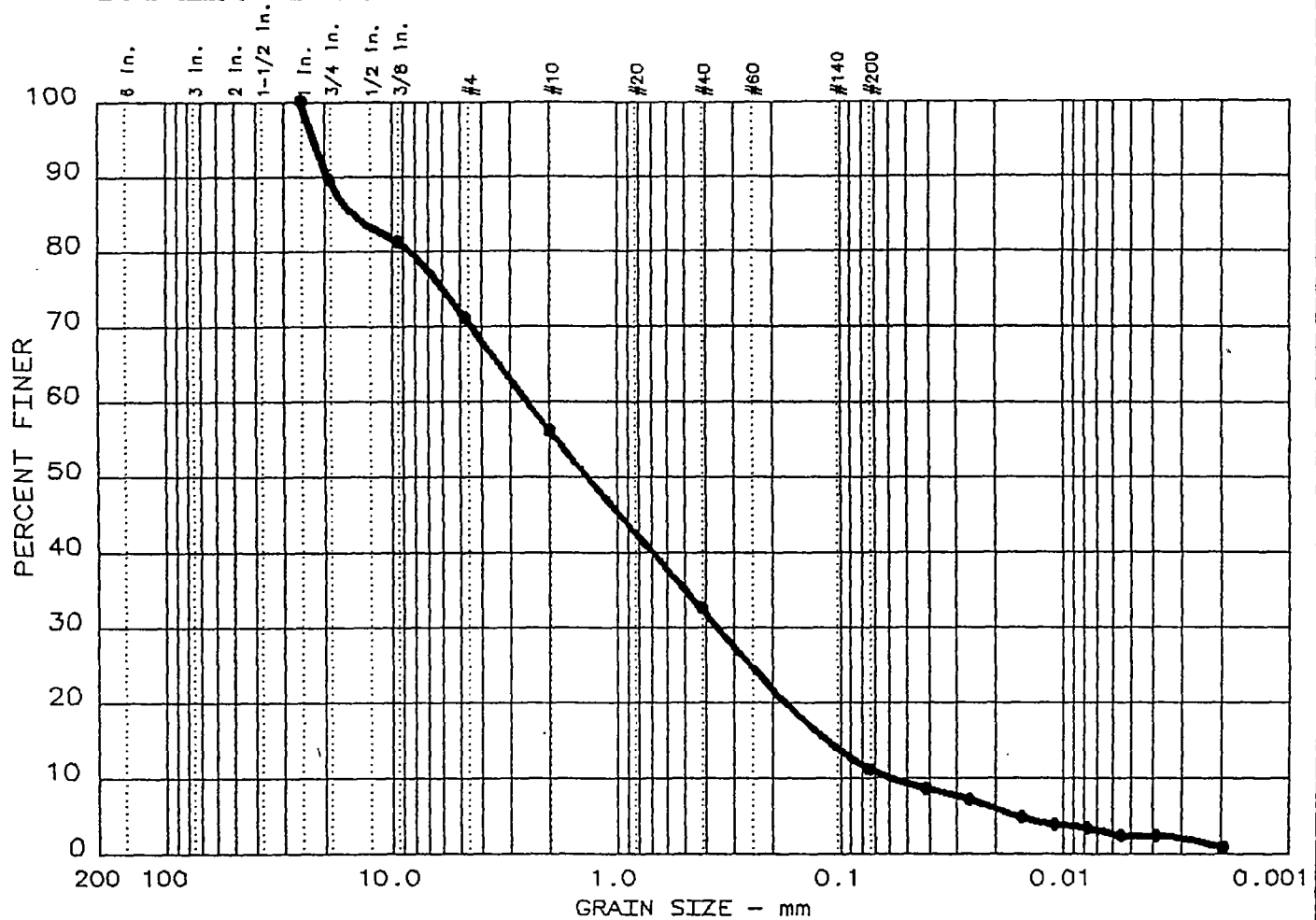
MATERIAL DESCRIPTION	USCS	AASHTO
• SANDY BROWN LEAN CLAY, TRACE GRAVEL	CL	

Project No.: Project: SR017646 • Location: A9H120186-013 D195A-1-01 Date: 8/26/99	Remarks: CLIENT: QUANTERRA, INC. JAR SAMPLES RECEIVED ON 8-13-99
GRAIN SIZE DISTRIBUTION TEST REPORT APPLIED CONSTRUCTION TECH., INC.	

Figure No. 03

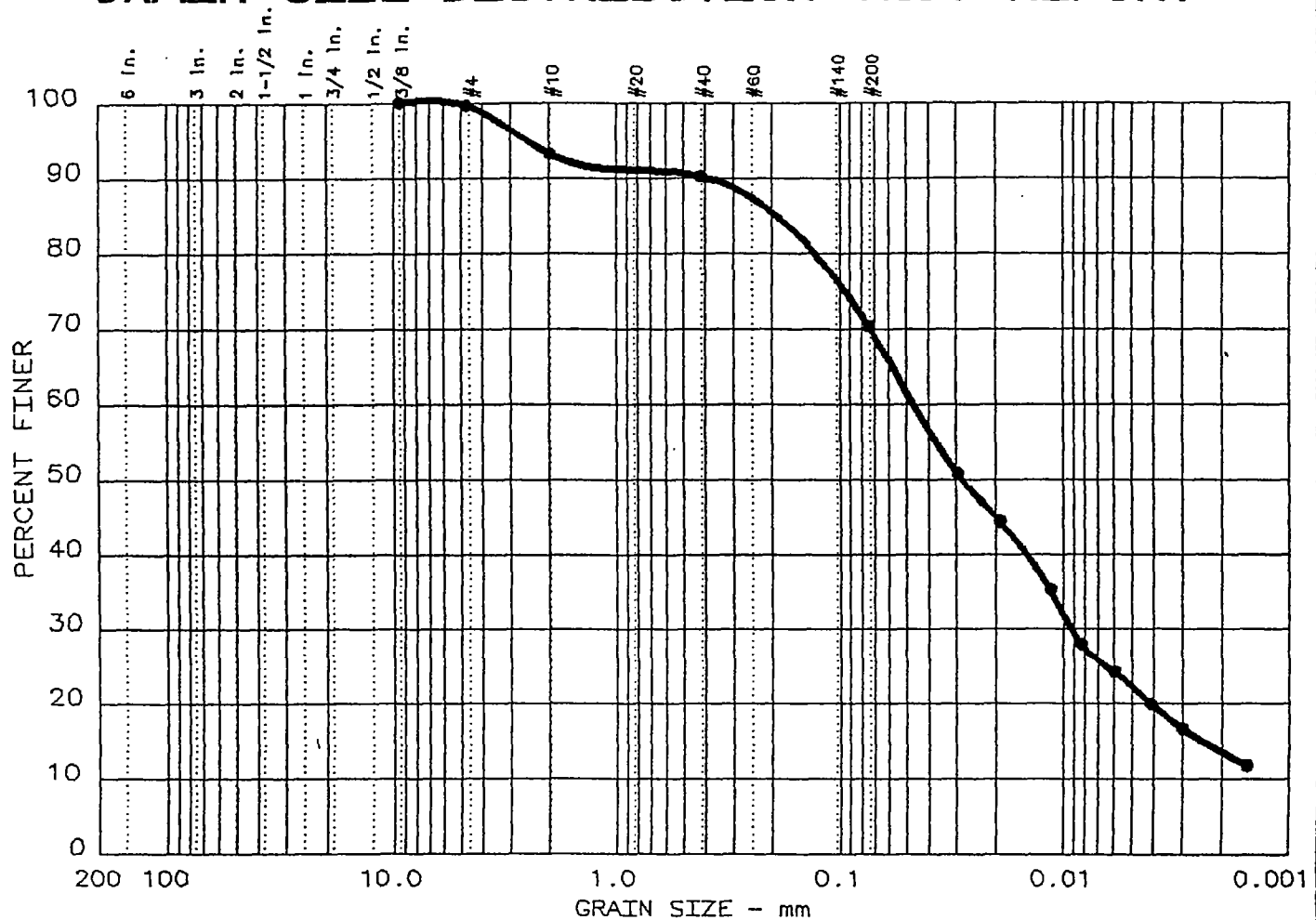
9.5-11.5

GRAIN SIZE DISTRIBUTION TEST REPORT



13.5-15.5

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.4	29.3	48.1	22.2

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		0.19		0.03	0.009	0.0024			

MATERIAL DESCRIPTION	USCS	AASHTO
GR LEAN CLAY, TR CINDERS, SAND, GRAV, COAL, SHALE	CL	

Project No.:

Project: SR017646

Location: A9H120186-015 D195G-1-01

Date: 8/26/99

Remarks:

CLIENT: QUANTERRA, INC.

JAR SAMPLES RECEIVED ON

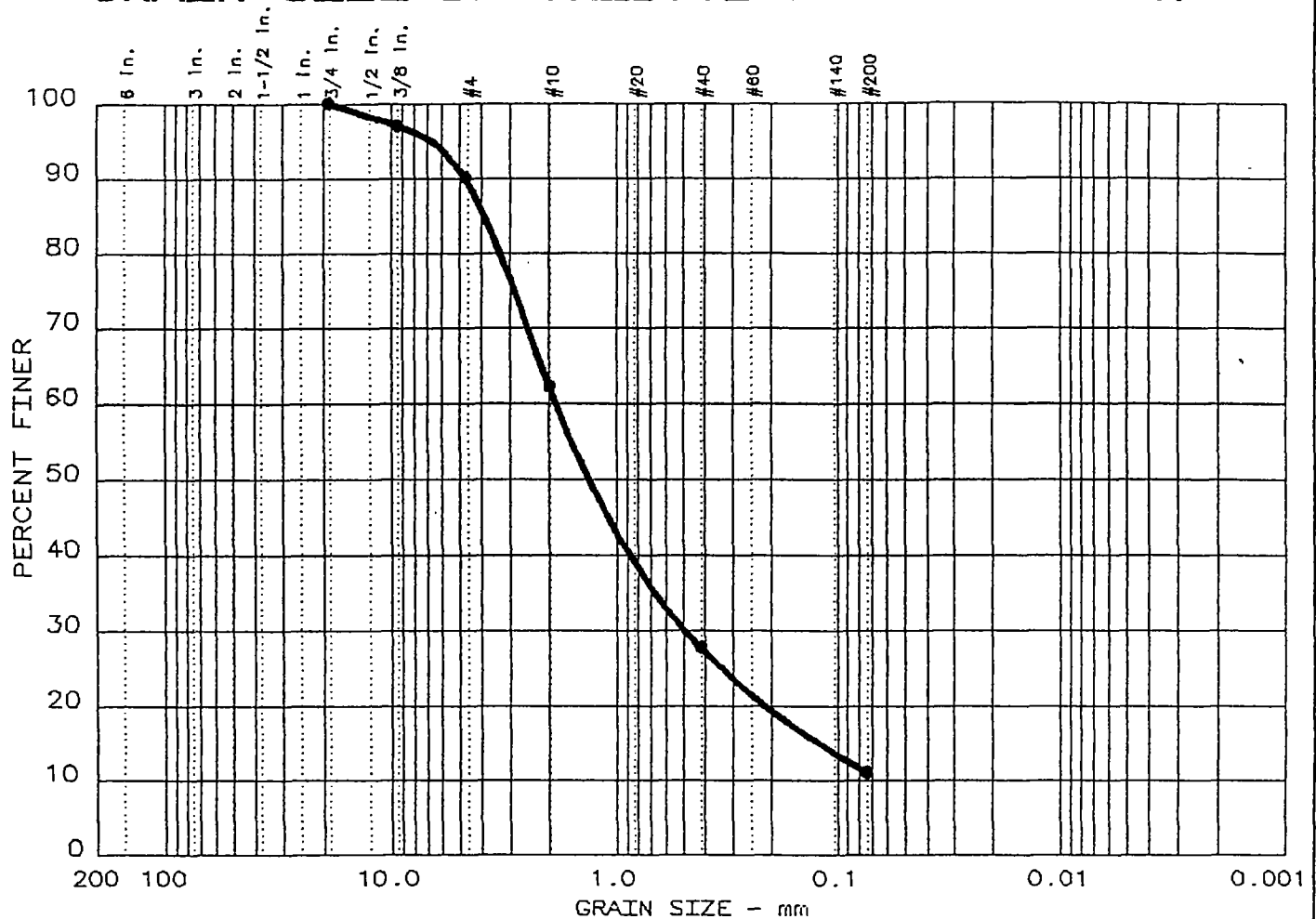
8-13-99

GRAIN SIZE DISTRIBUTION TEST REPORT

APPLIED CONSTRUCTION TECH., INC.

Figure No. 05

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	10.0	78.9	11.1	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		3.89	1.86	1.32	0.490	0.1216			

MATERIAL DESCRIPTION	USCS	AASHTO
● BLACK COAL		

Project No.:
 Project: SR017646
 ● Location: A9H120186-016 D195L-1-01

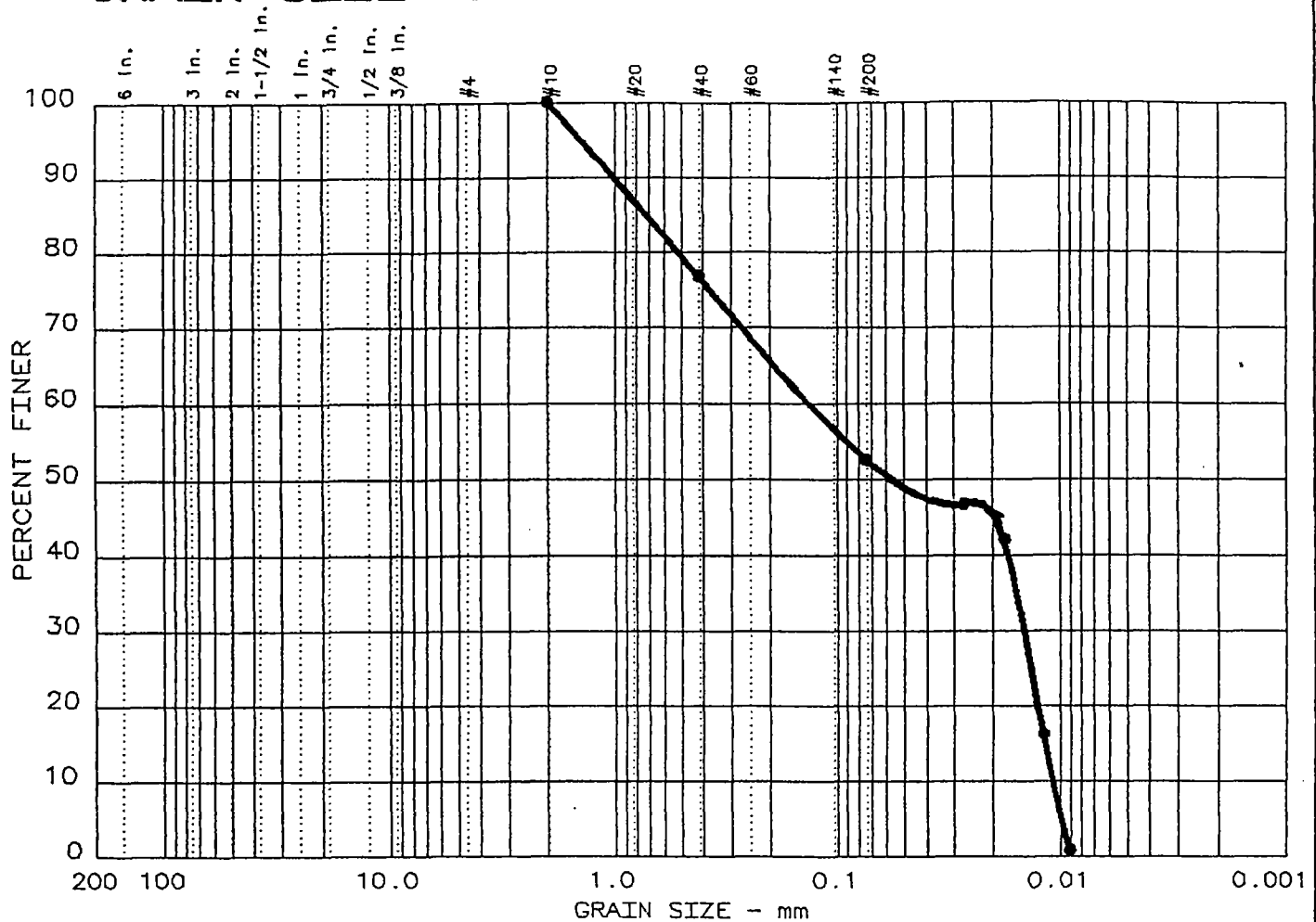
Date: 8/26/99

GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:
 CLIENT: QUANTERRA, INC.
 JAR SAMPLES RECEIVED ON
 8-13-99

Figure No. 06

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	47.4	52.6	

[illegible]

MATERIAL DESCRIPTION	USCS	AASHTO
● LIGHT BROWN AND WHITE CRUSHED CHALKY MATERIAL		

Project No.:
Project: SR017646
● Location: A9H120186-017 D195R-1-01

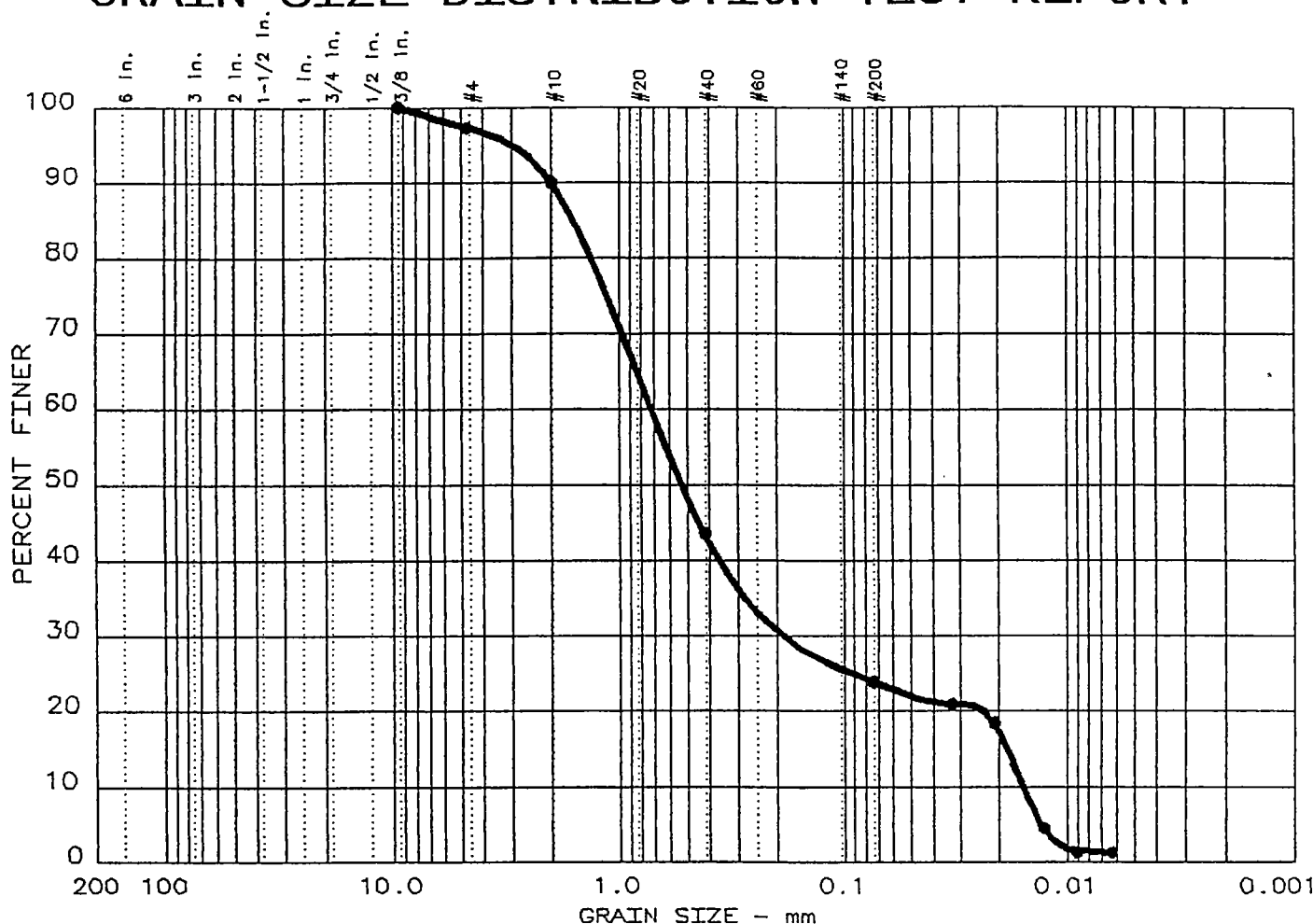
Date: 8/26/99

GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:
CLIENT: QUANTERRA, INC.
JAR SAMPLES RECEIVED ON
8-13-99

Figure No. 07

6-2



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	2.7	73.4	23.9	

[illegible]

MATERIAL DESCRIPTION	USCS	AASHTO
● WHITE CRUSHED CHALKY MATERIAL		

Project No.:
Project: SR017646
● Location: A9H120186-018 D195T-1-01

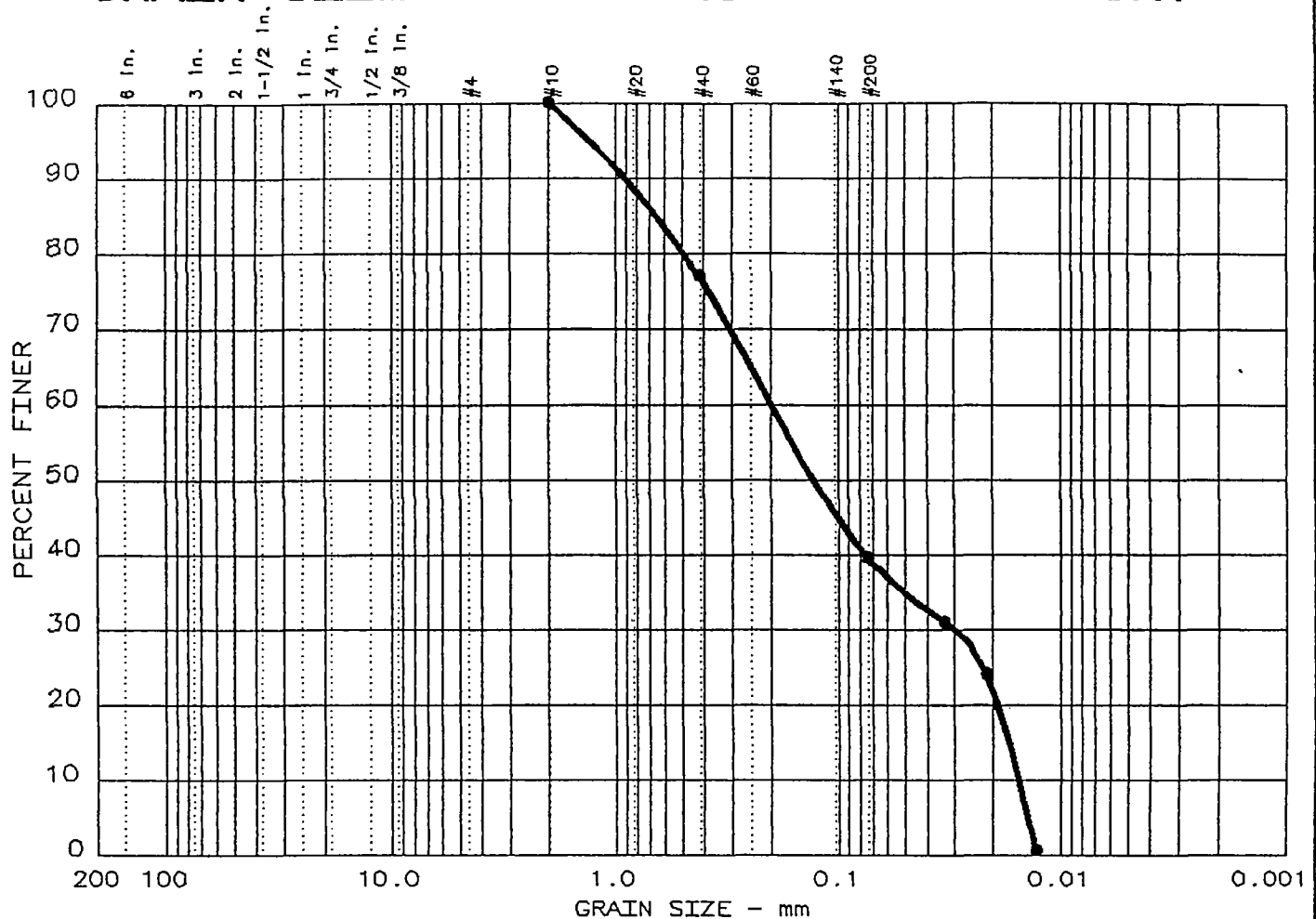
Date: 8/26/99

GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:
CLIENT: QUANTERRA, INC.
JAR SAMPLES RECEIVED ON
8-13-99

Figure No. 08

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	60.3	39.7	

[illegible]

MATERIAL DESCRIPTION	USCS	AASHTO
● WHITE CRUSHED CHALKY MATERIAL		

Project No.:
Project: SR017646
● Location: A9H120186-019 D195X-1-01

Date: 8/26/99

GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:

CLIENT: QUANTERRA, INC.

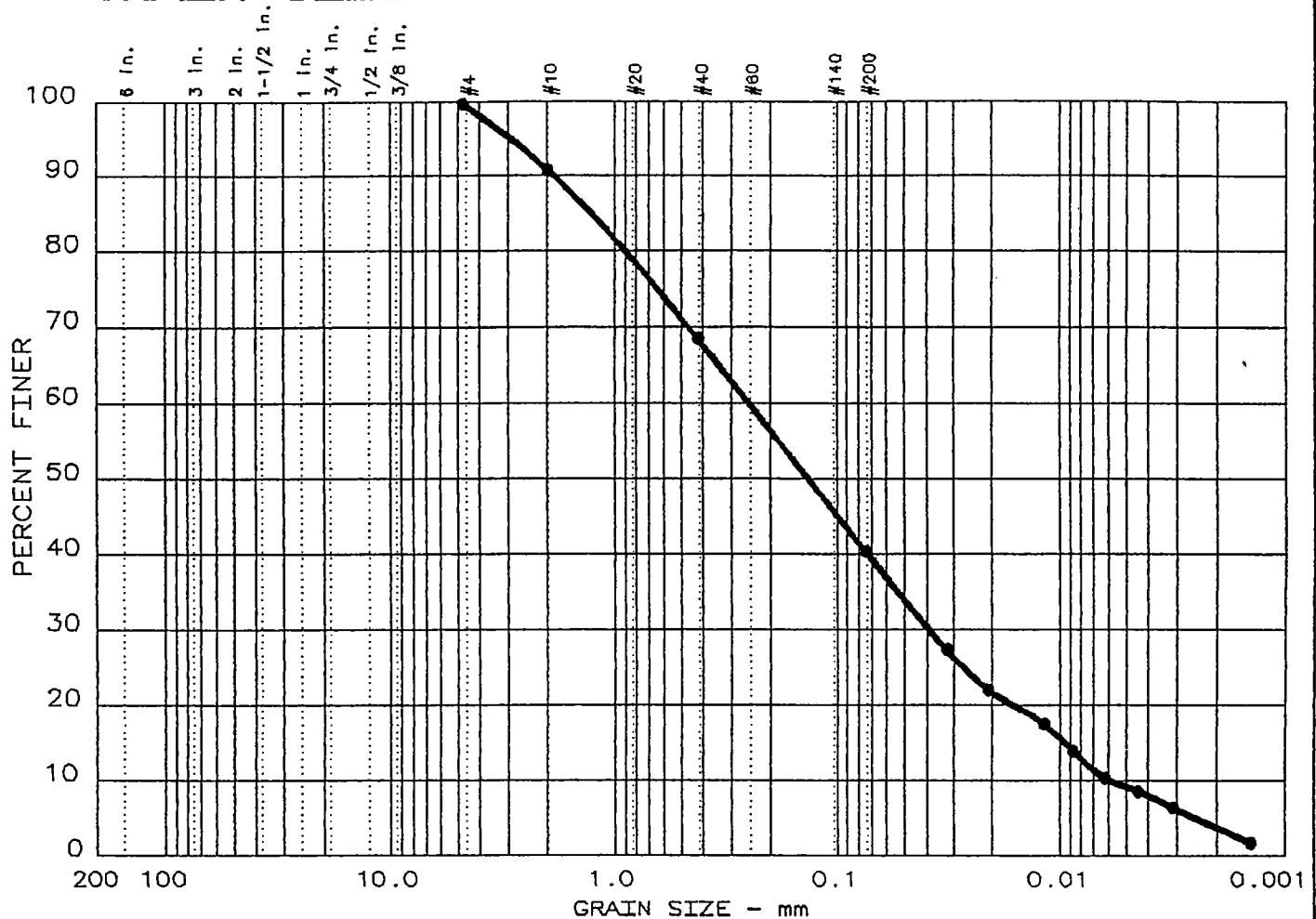
JAR SAMPLES RECEIVED ON

8-13-99

Figure No. 09

15-15.5

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.4	59.3	31.2	9.1

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		1.27	0.25	0.13	0.039	0.0095	0.0060	1.04	41.2

MATERIAL DESCRIPTION	USCS	AASHTO
● BROWN & GRAY SILTY-CLAYEY SAND, TRACE GRAVEL	SC-SM	

Project No.:
 Project: SR017646
 ● Location: A9H120186-020 D1962-1-01

Date: 8/26/99

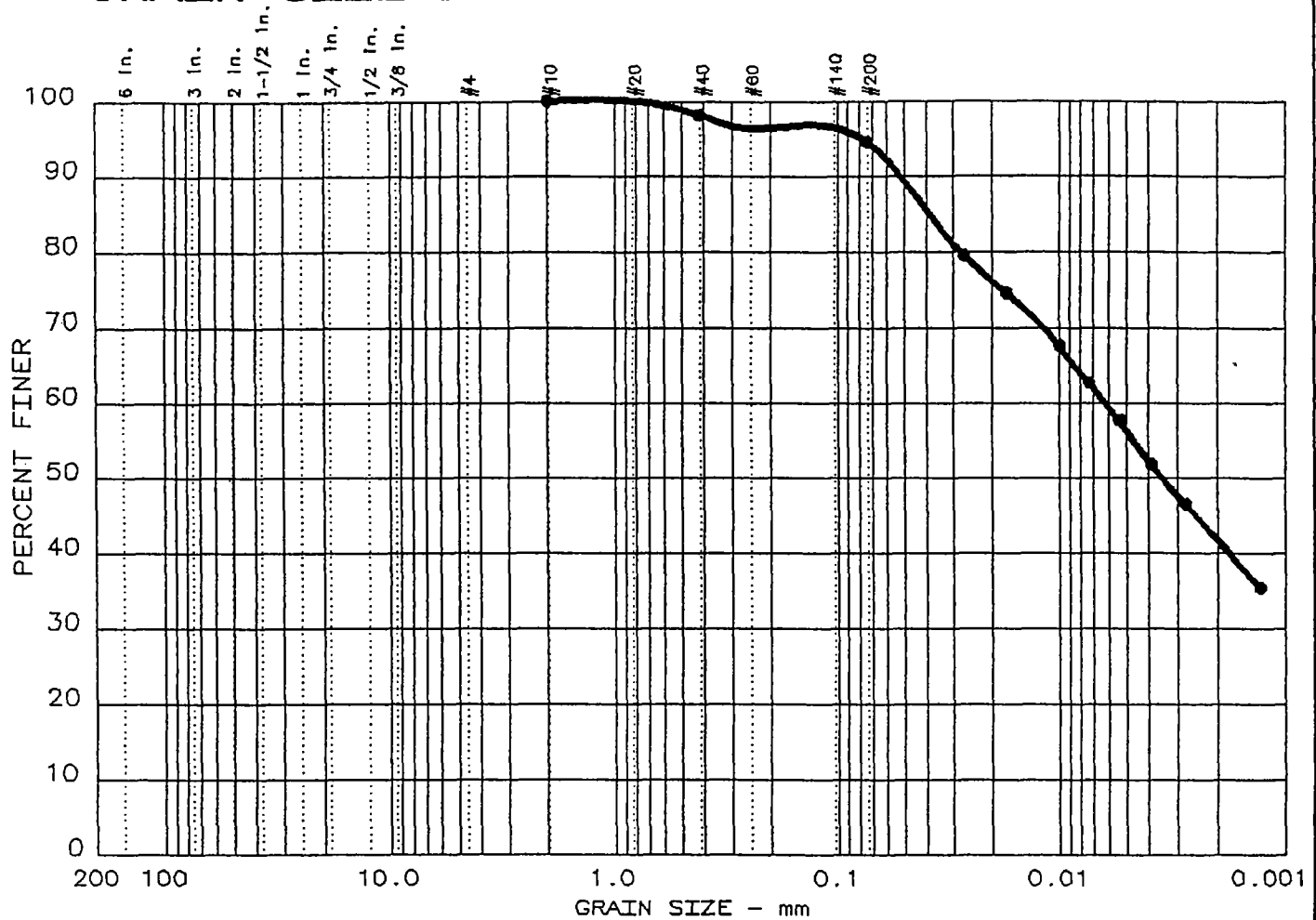
GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:
 CLIENT: QUANTERRA, INC.
 JAR SAMPLES RECEIVED ON
 8-13-99

Figure No. 10

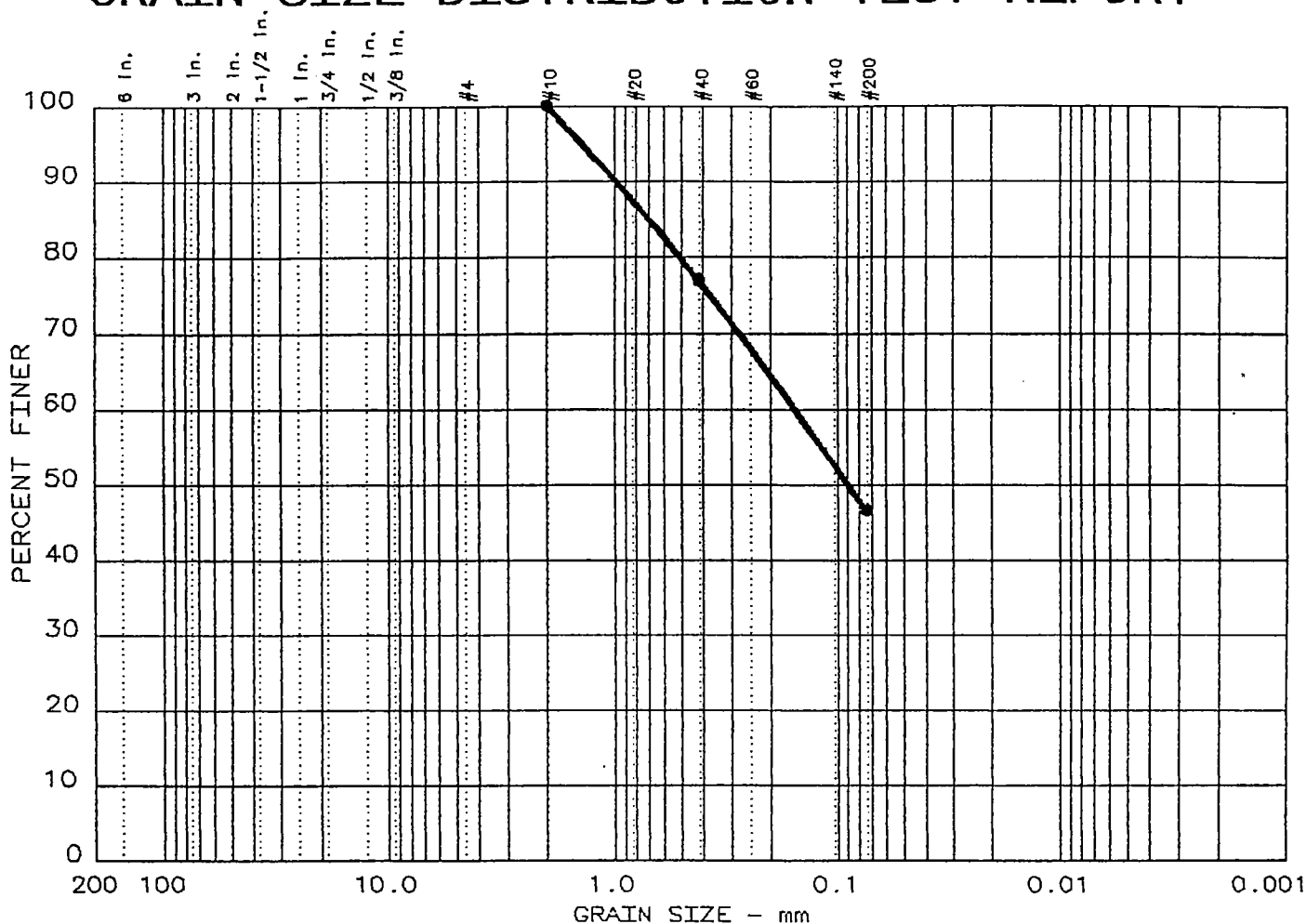
15.5-16

GRAIN SIZE DISTRIBUTION TEST REPORT



#6 (2-4)

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	53.4	46.6	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		0.70	0.15	0.09					

MATERIAL DESCRIPTION	USCS	AASHTO
● BLACK COAL		

Project No.:
 Project: SR017646
 ● Location: A9H120186-022 D196E-1-01

Date: 8/26/99

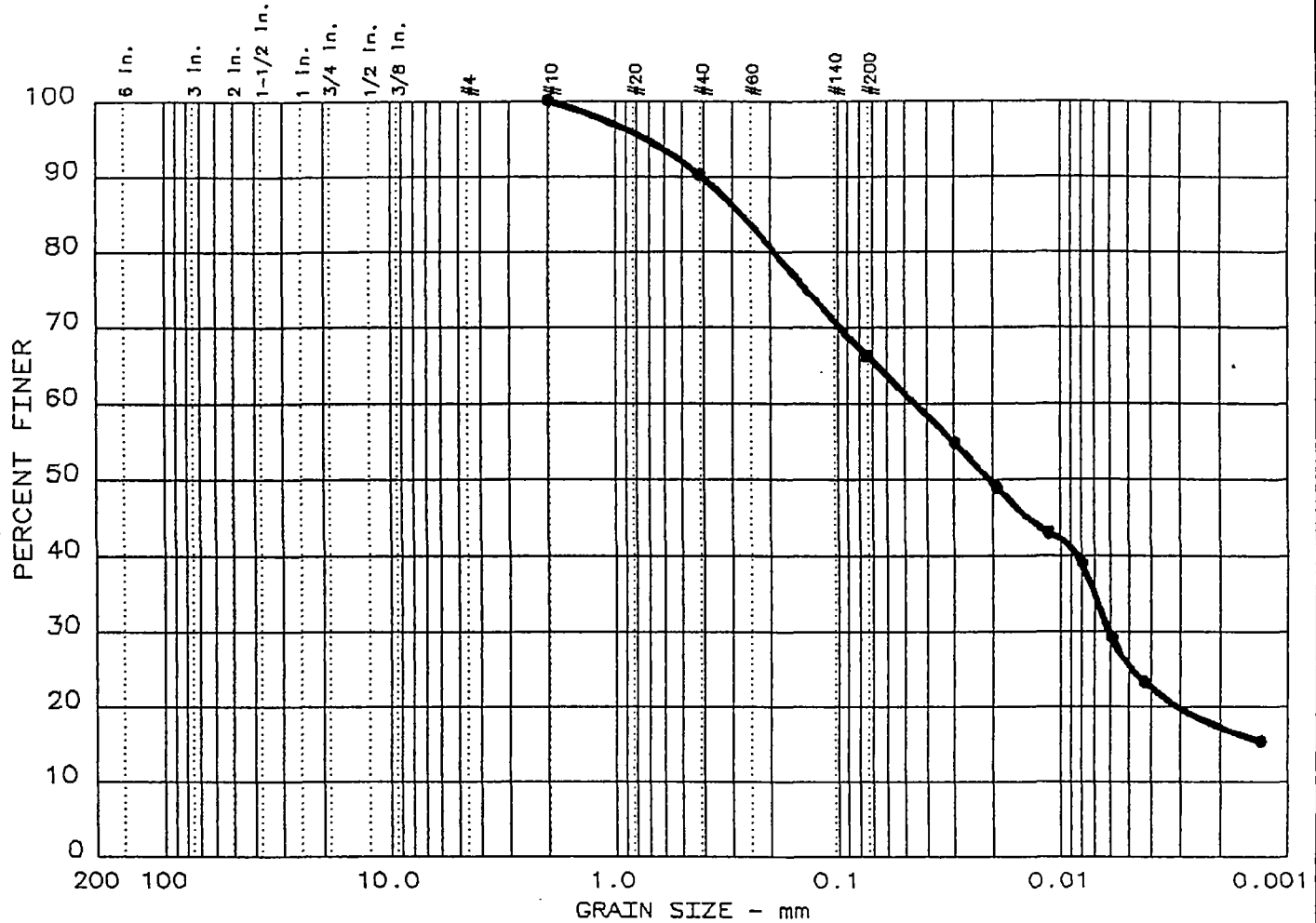
GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:
 CLIENT: QUANTERRA, INC.
 JAR SAMPLES RECEIVED ON
 8-13-99

Figure No. 12

5-6

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	33.8	40.8	25.4

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		0.27		0.02	0.006				

MATERIAL DESCRIPTION	USCS	AASHTO
TAN CRUSHED CHALKY MATERIAL		

Project No.:
 Project: SR017646
 • Location: A9H120186-023 D196H-1-01
 Date: 8/26/99

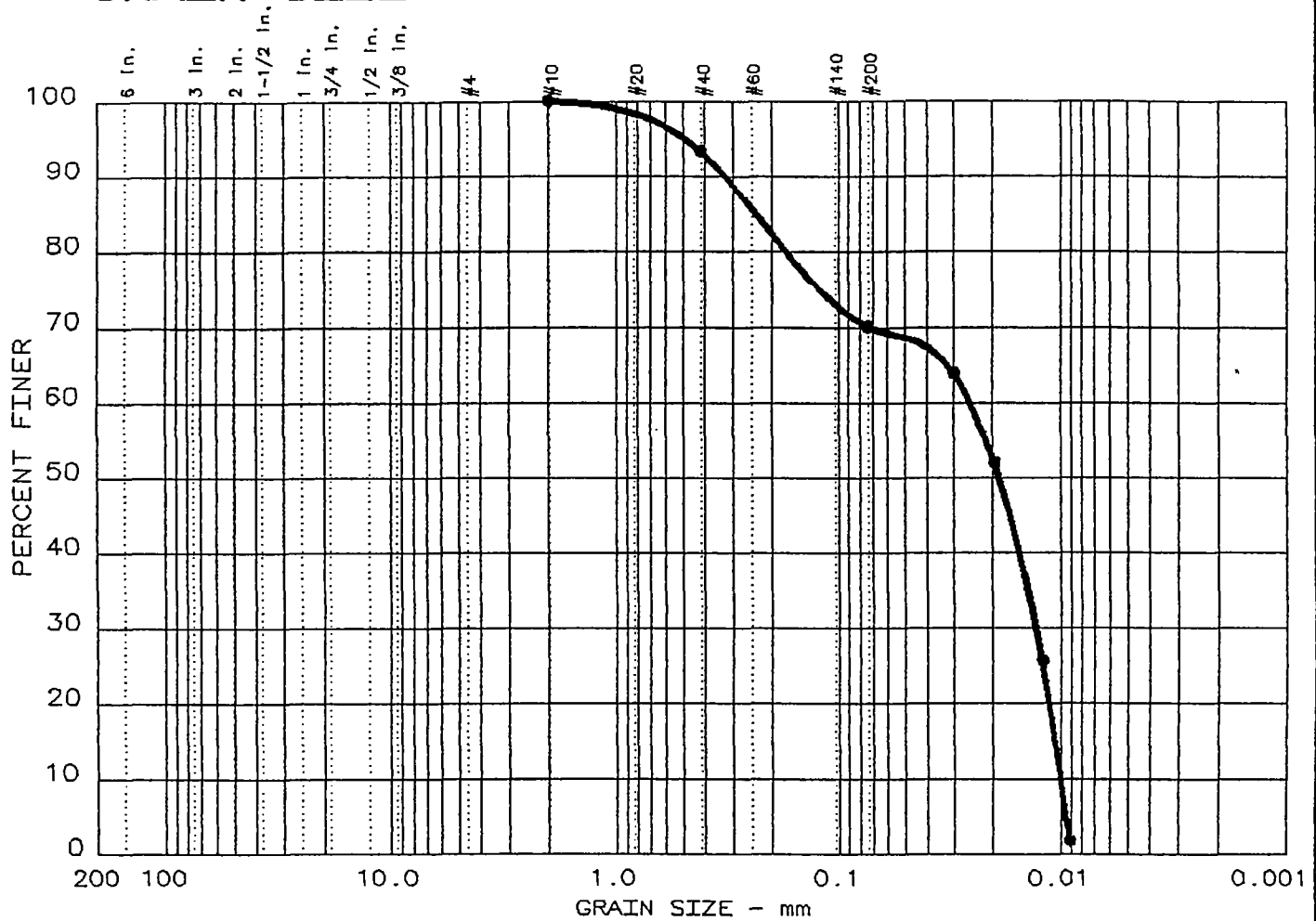
GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:
 CLIENT: QUANTERRA, INC.
 JAR SAMPLES RECEIVED ON
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Figure No. 13

(8-10)

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	29.9	70.1	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		0.23		0.02	0.013	0.0106	0.0100	0.67	2.5

MATERIAL DESCRIPTION	USCS	AASHTO
● WHITE CHALKY MATERIAL		

Project No.:
 Project: SR017646
 ● Location: A9H120186-024 D196K-1-01

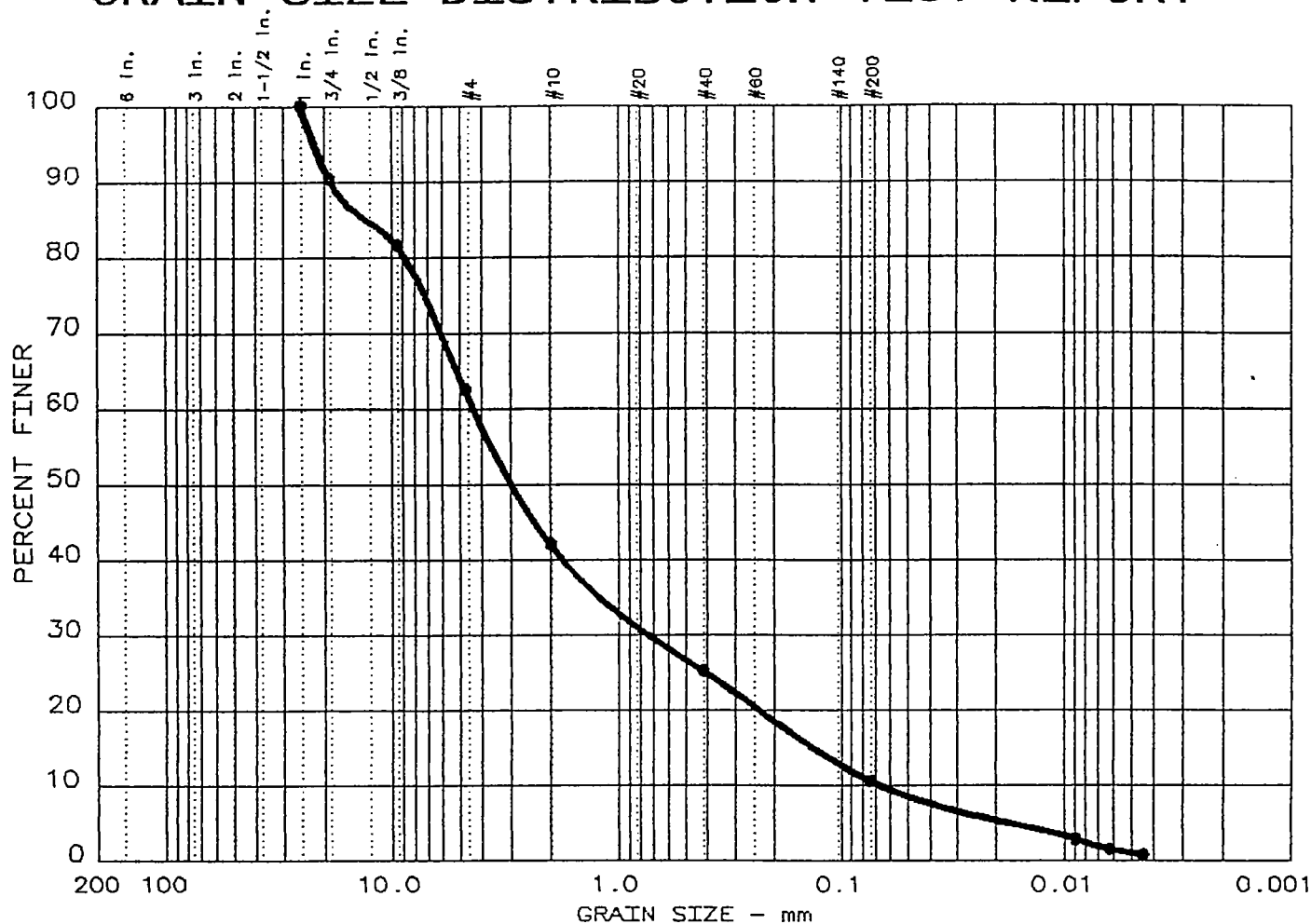
Date: 8/26/99

Remarks:
 CLIENT: QUANTERRA, INC.
 JAR SAMPLES RECEIVED ON
 8-13-99

GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Figure No. 14

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	37.5	52.0	9.6	0.9

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		13.18	4.37	2.95	0.741	0.1318	0.0653	1.93	66.8

MATERIAL DESCRIPTION	USCS	AASHTO
● GRAY SILTY SAND W/ GRAV, SOME CHALKY MAT'L, COAL	SW-SM	

Project No.:
 Project: SR017646
 ● Location: A9H120186-025 D196M-1-01

Date: 8/26/99

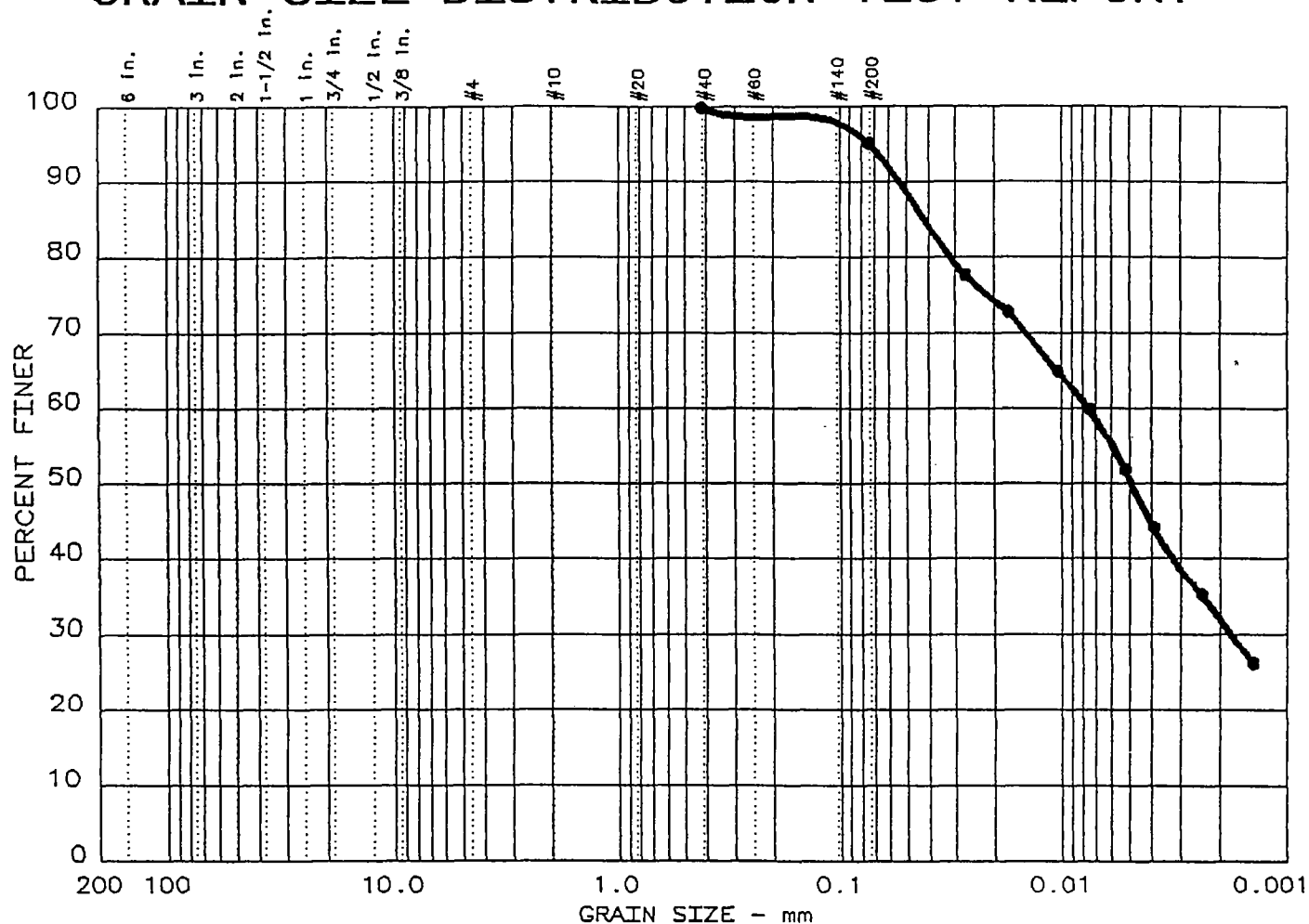
Remarks:

CLIENT: QUANTERRA, INC.
 JAR SAMPLES RECEIVED ON
 8-13-99

GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Figure No. 15

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	5.0	44.4	50.6

[illegible]

MATERIAL DESCRIPTION	USCS	AASHTO
● GRAY LEAN CLAY, TRACE SAND, ORGANICS	CL	

Project No.:
Project: SR017646
● Location: A9H120186-026 D196P-1-01

Date: 8/26/99

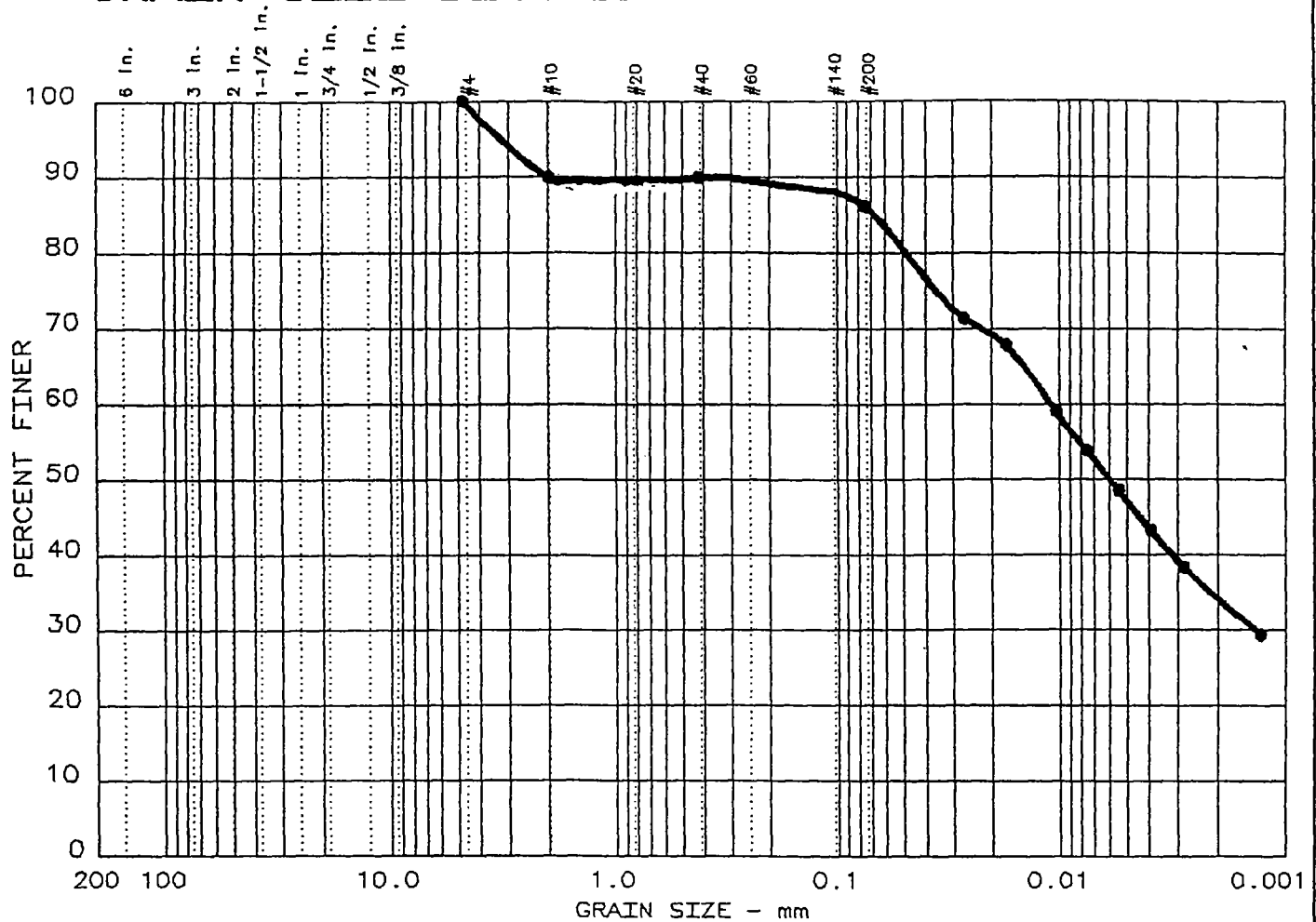
GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:
CLIENT: QUANTERRA, INC.
JAR SAMPLES RECEIVED ON
8-13-99

Figure No. 16

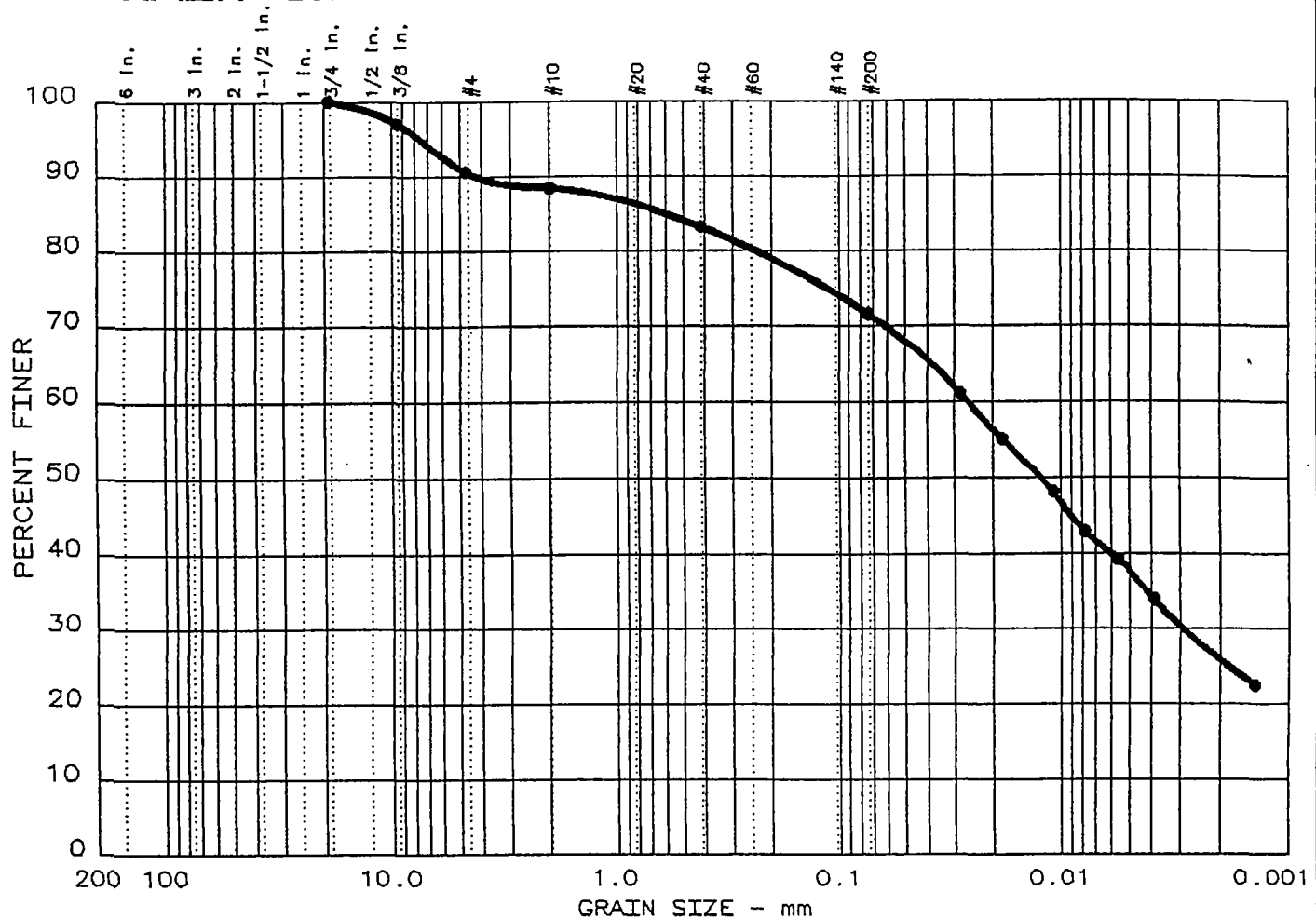
19.2 - 20

GRAIN SIZE DISTRIBUTION TEST REPORT



H7 (1-2)

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	9.5	19.0	33.8	37.7

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		0.62		0.01	0.003				

MATERIAL DESCRIPTION	USCS	AASHTO
● BROWN LEAN CLAY, LITTLE SAND, TRACE GRAVEL	CL	

Project No.:

Project: SR017646

● Location: A9H120186-028 D1971-1-01

Date: 8/26/99

Remarks:

CLIENT: QUANTERRA, INC.

JAR SAMPLES RECEIVED ON

8-13-99

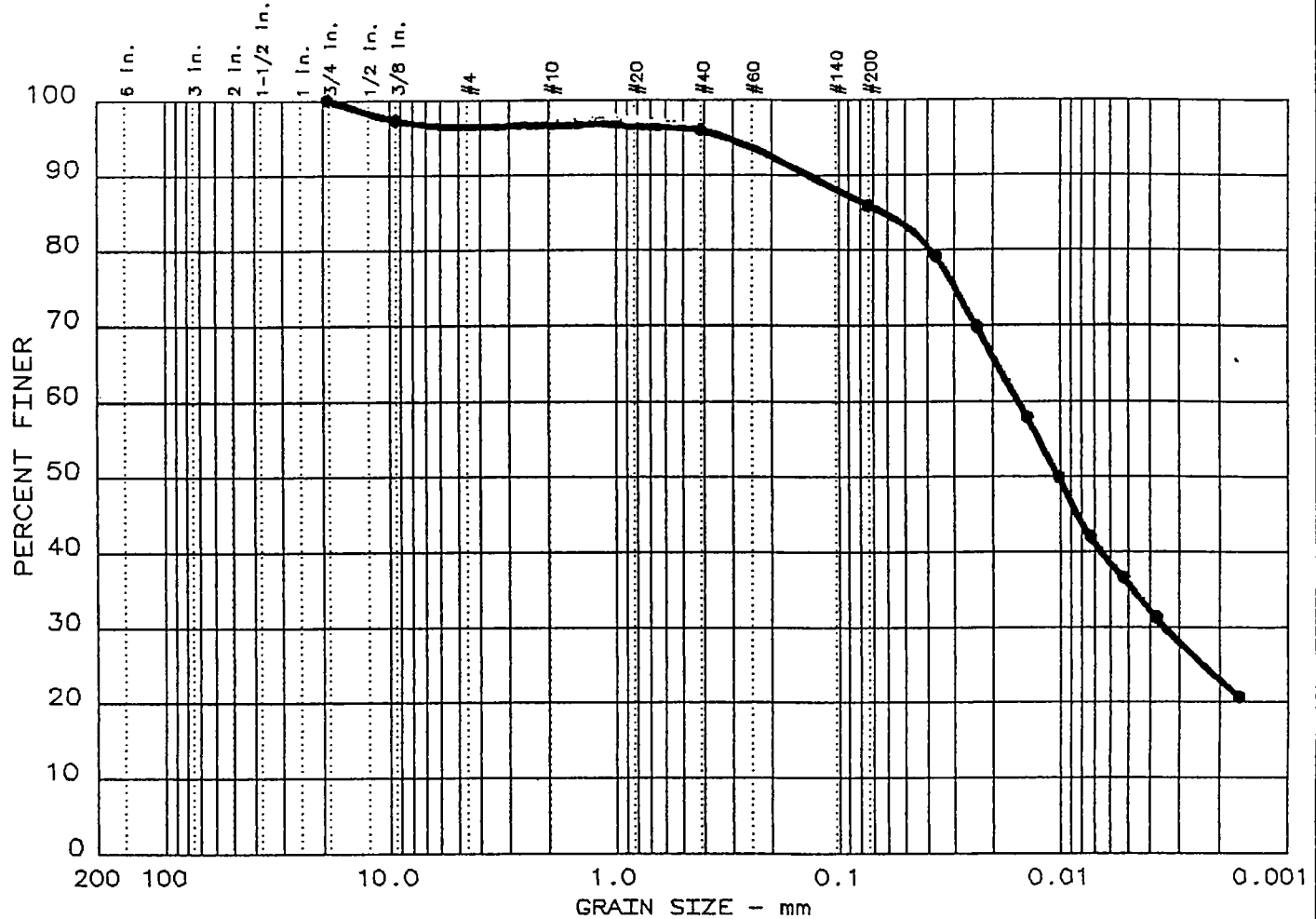
GRAIN SIZE DISTRIBUTION TEST REPORT

APPLIED CONSTRUCTION TECH., INC.

Figure No. 18

10-12

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	3.6	10.5	50.0	35.9

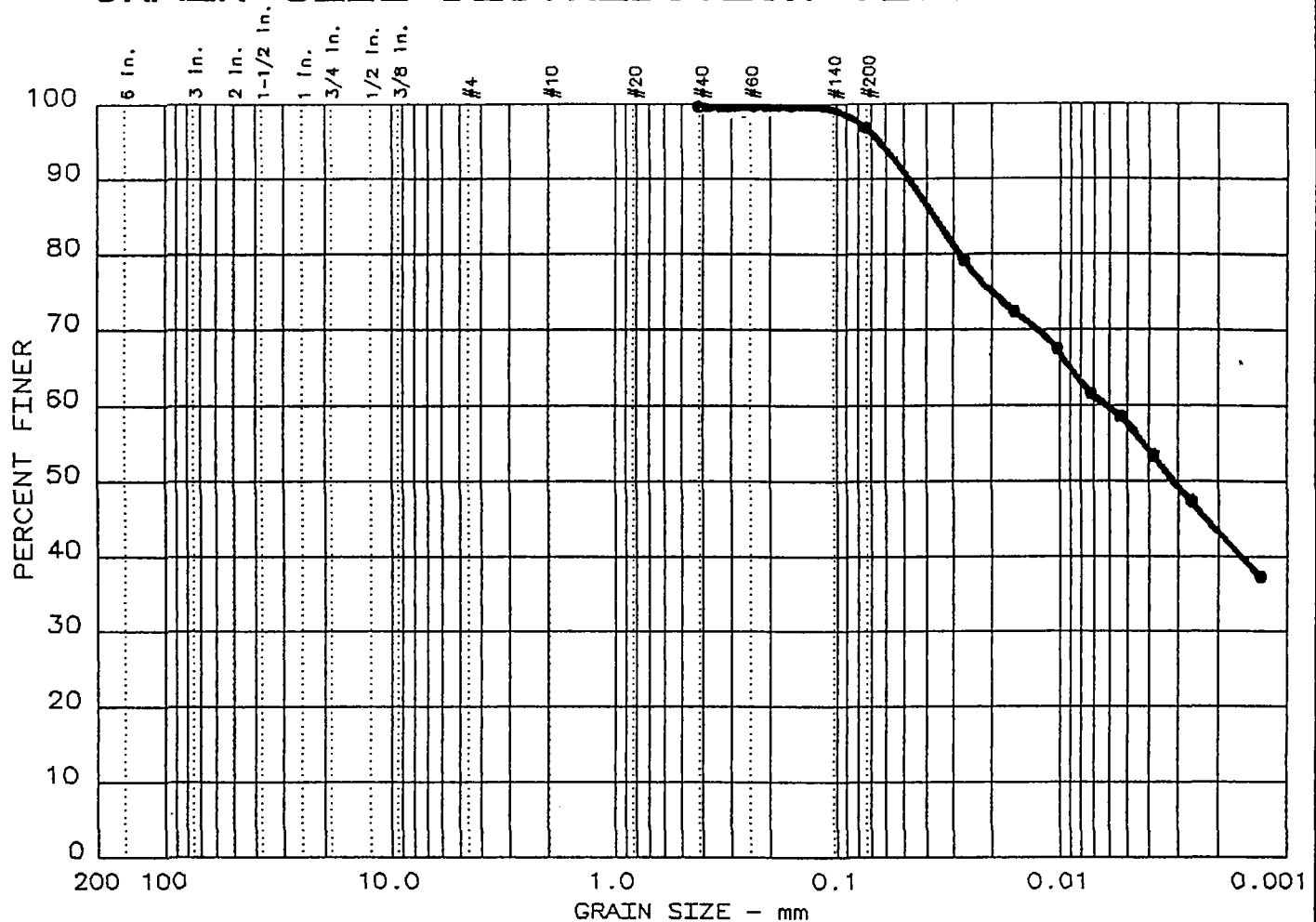
LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
				0.01	0.003				

MATERIAL DESCRIPTION	USCS	AASHTO
● BLACK ORGANIC CLAY WITH FIBERS		

Project No.: Project: SR017646 ● Location: A9H120186-029 D1975-1-01 Date: 8/27/99	Remarks: CLIENT: QUANTERRA, INC. JAR SAMPLES RECEIVED ON 8-13-99
GRAIN SIZE DISTRIBUTION TEST REPORT APPLIED CONSTRUCTION TECH., INC.	

(12-14)

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	3.3	39.1	57.6

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
				0.00					

MATERIAL DESCRIPTION	USCS	AASHTO
• WHITE CRUSHED CHALKY MATERIAL		

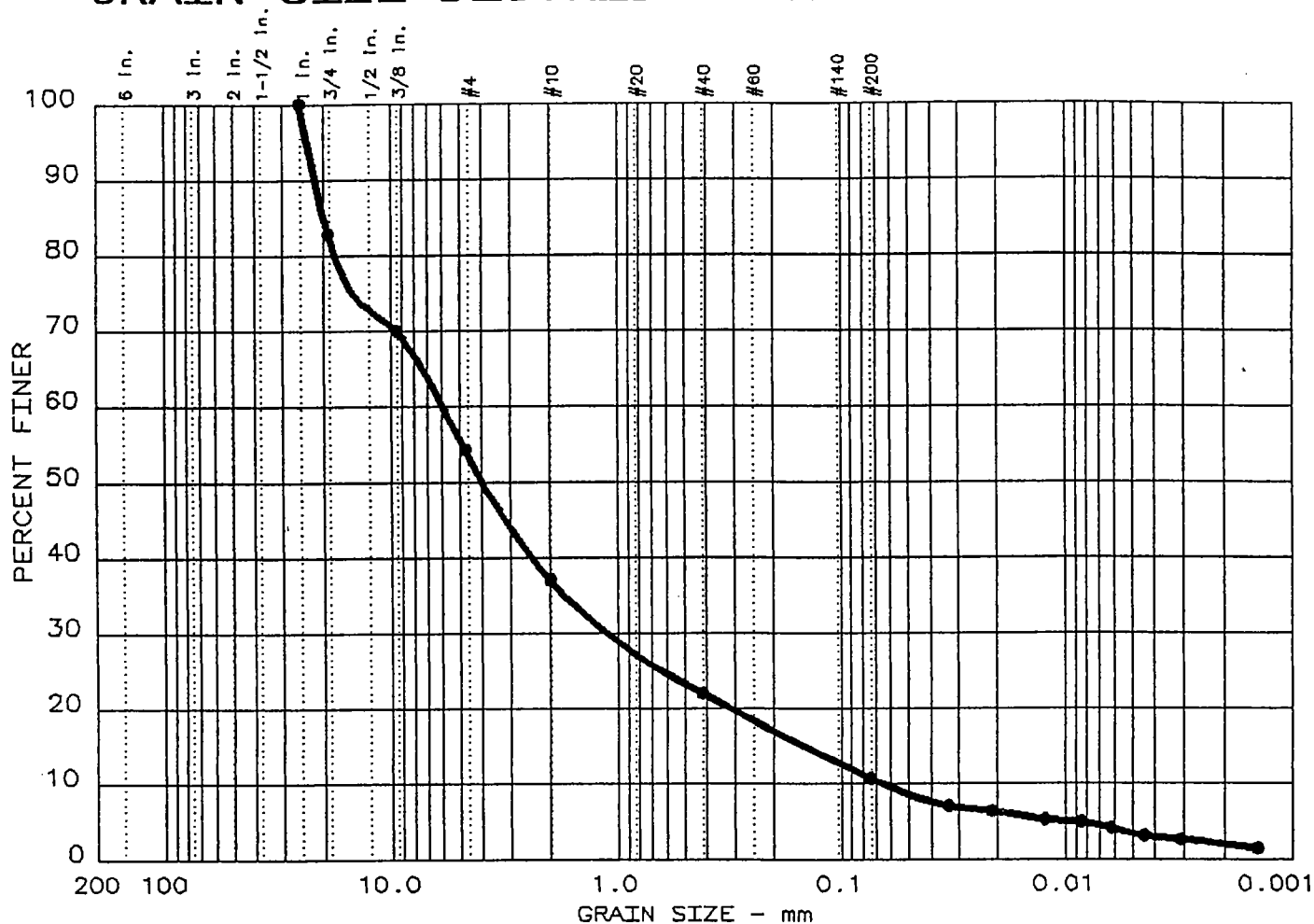
Project No.:
 Project: SR017646
 • Location: A9H120186-030 D1978-1-01
 Date: 8/26/99

GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:
 CLIENT: QUANTERRA, INC.
 JAR SAMPLES RECEIVED ON
 8-13-99

Figure No. 20

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	45.7	43.6	7.3	3.4

[illegible]

MATERIAL DESCRIPTION	USCS	AASHTO
● CRUSHED CONCRETE		

Project No.:
Project: SR017646
● Location: A9H120186-031 D197D-1-01

Date: 8/26/99

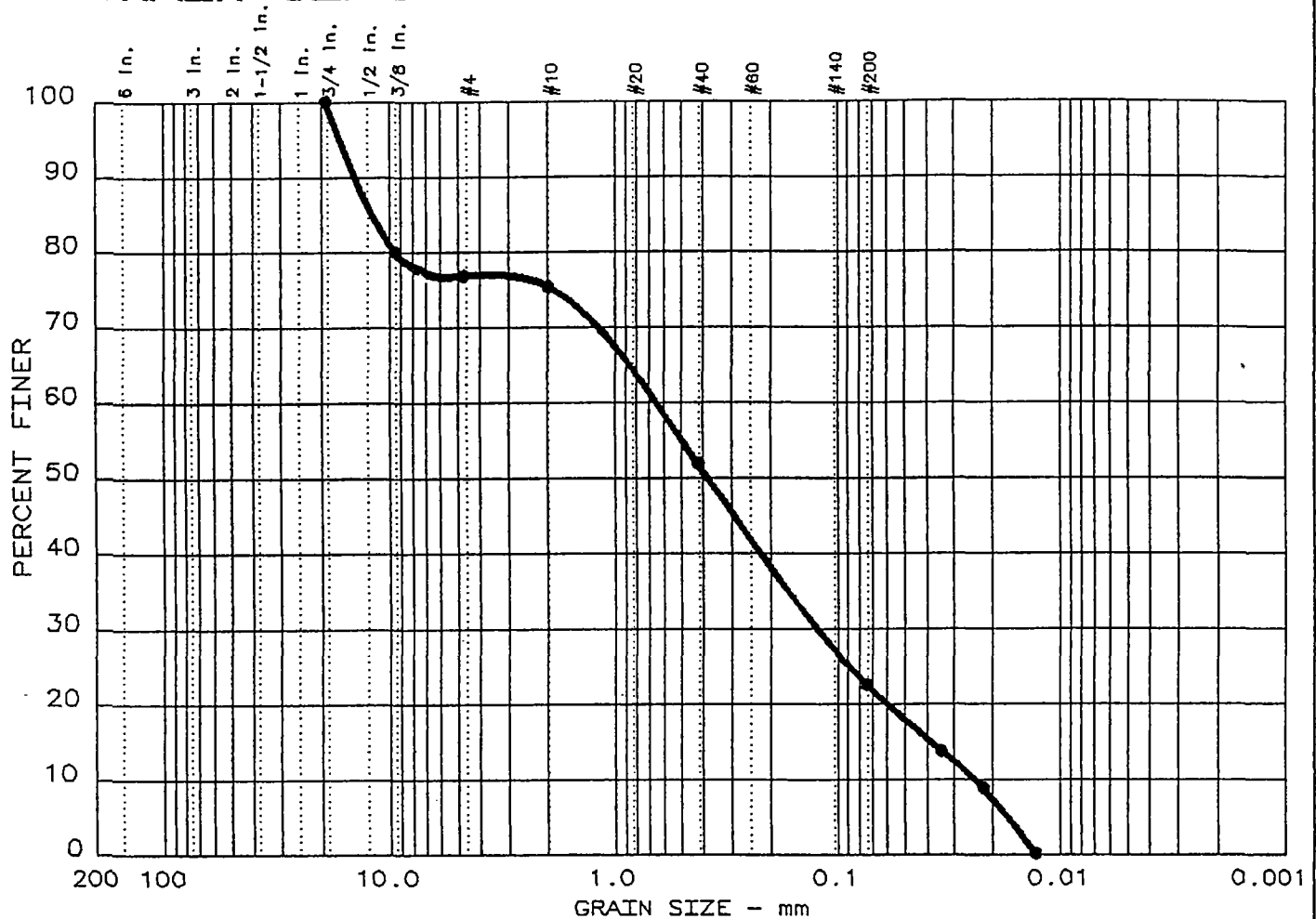
GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:
CLIENT: QUANTERRA, INC.
JAR SAMPLES RECEIVED ON
8-13-99

Figure No. 21

(0-9.0)

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	23.3	54.2	22.5	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		11.89	0.65	0.38	0.123	0.0385	0.0240	0.98	26.9

MATERIAL DESCRIPTION	USCS	AASHTO
• WHITE CRUSHED CHALKY MATERIAL		

Project No.:
 Project: SR017646
 • Location: A9H120186-032 D197G-1-01
 Date: 8/26/99

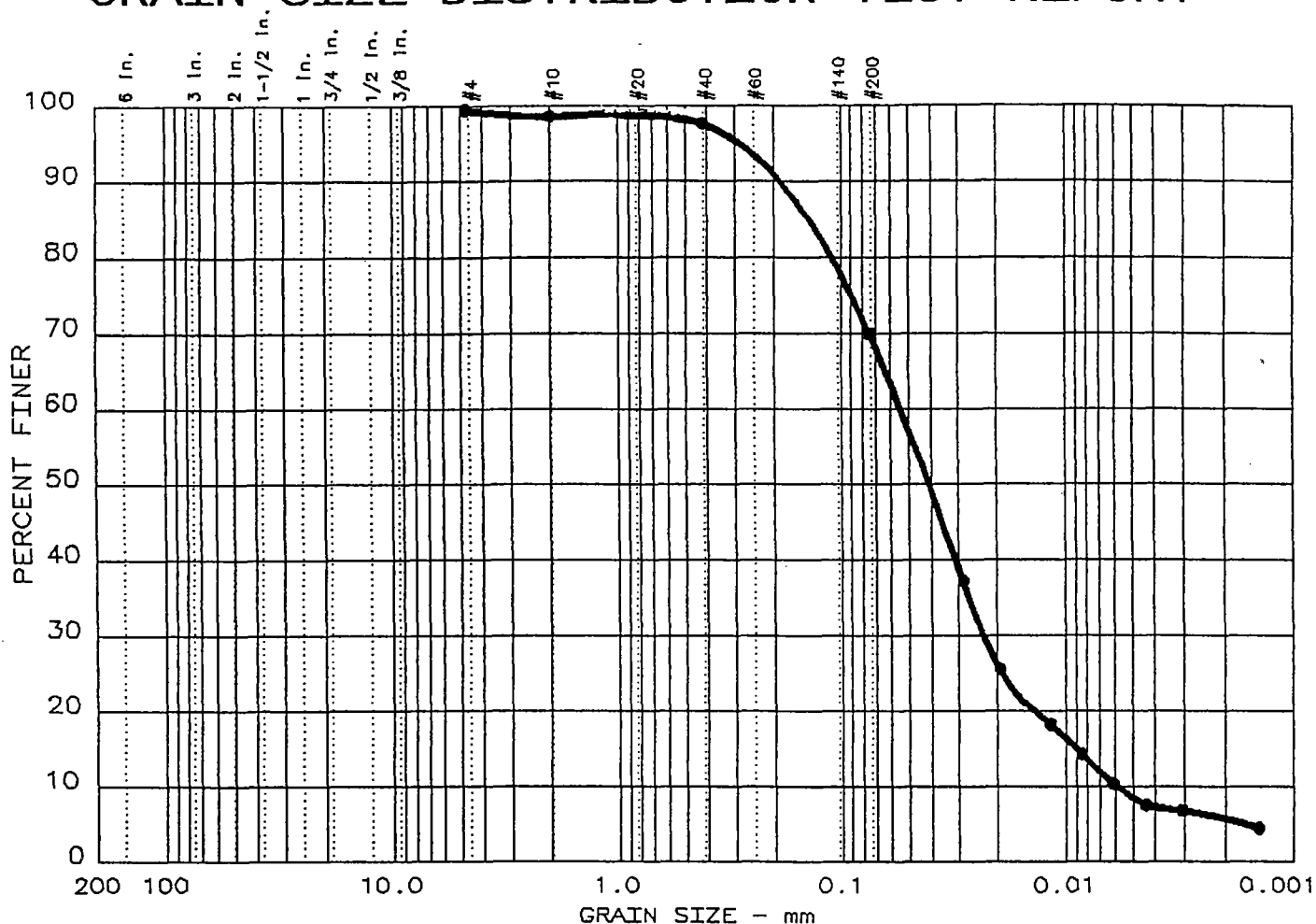
GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:
 CLIENT: QUANTERRA, INC.
 JAR SAMPLES RECEIVED ON
 8-13-99

Figure No. 22

(10-12)

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.6	29.5	61.4	8.5

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		0.14		0.04	0.023	0.0089	0.0059	1.64	9.2

MATERIAL DESCRIPTION	USCS	AASHTO
● DARK GRAY SILTY CLAY, SOME SAND, TR GRAVEL, ORGNC	CL-ML	

Project No.:
 Project: SR017646
 ● Location: A9H120186-033 D197L-1-01

Date: 8/26/99

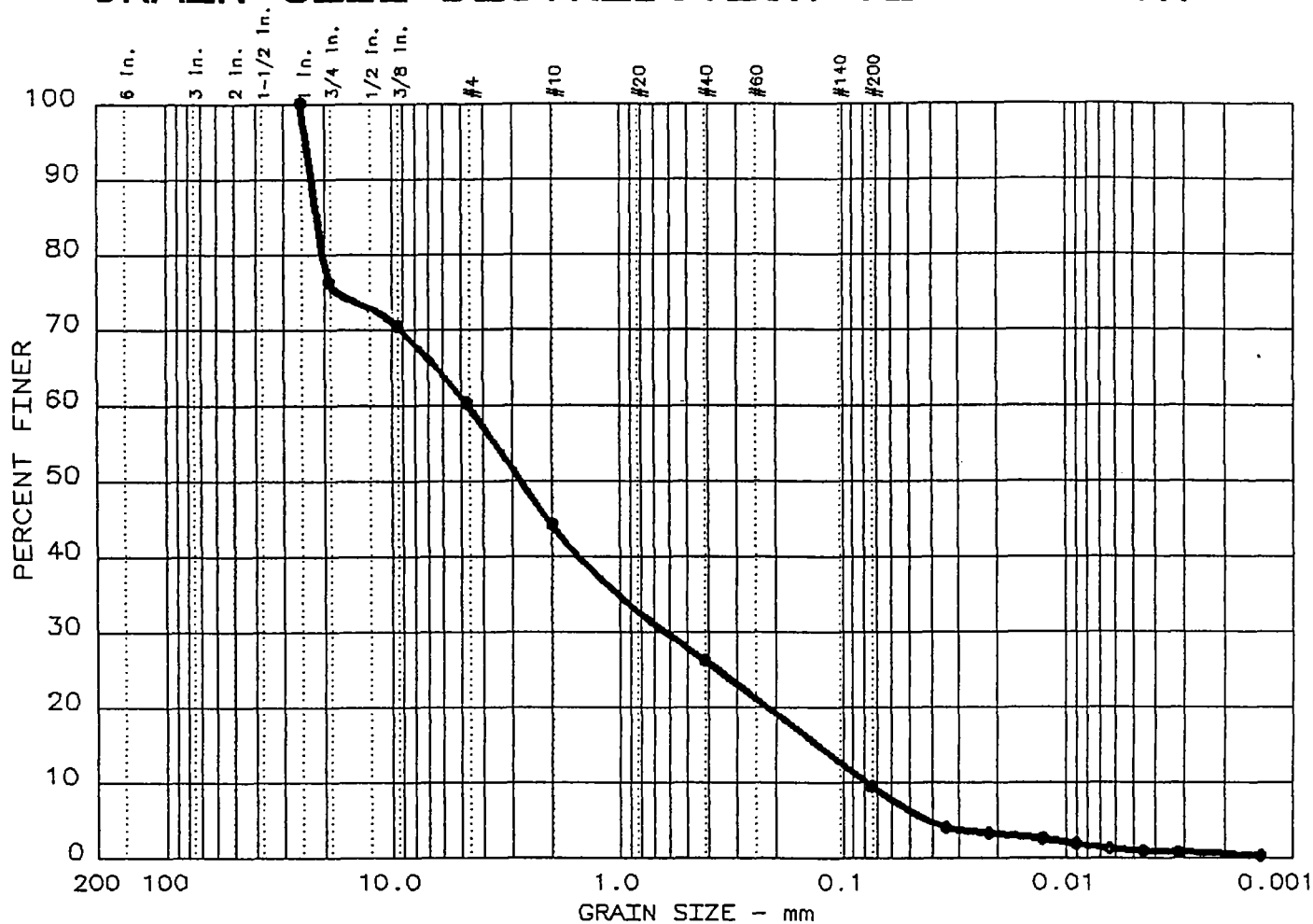
GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:
 CLIENT: QUANTERRA, INC.
 JAR SAMPLES RECEIVED ON
 8-13-99

Figure No. 23

10-(3-5)

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	39.7	50.7	8.5	1.1

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		21.63	4.68	2.72	0.631	0.1303	0.0767	1.11	61.0

MATERIAL DESCRIPTION	USCS	AASHTO
● DARK BROWN WELL-GRADED SAND WITH SILT AND GRAVEL	SW-SM	

Project No.:
 Project: SR017646
 ● Location: A9H120186-034 D197P-1-01

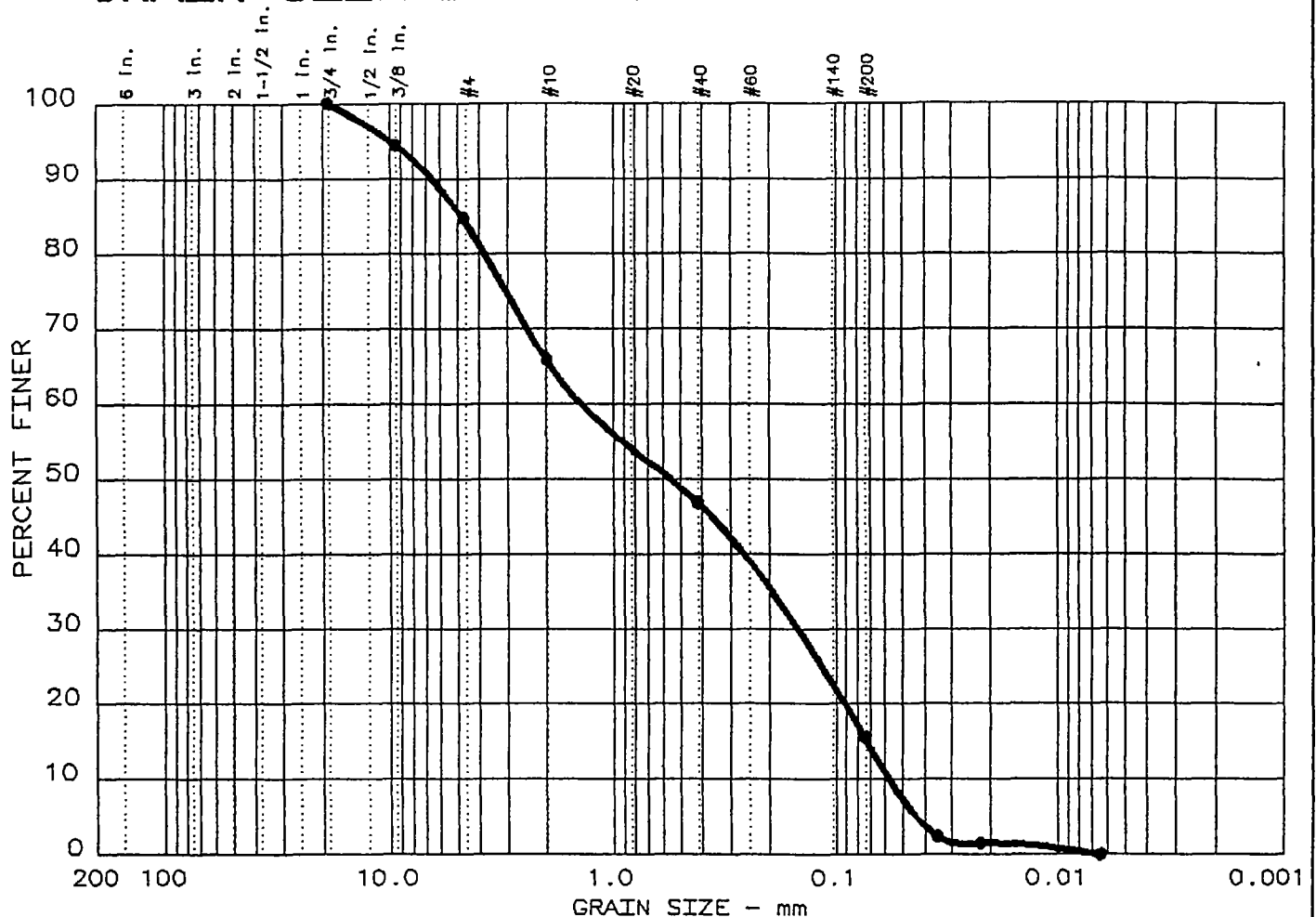
Date: 8/26/99

GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:
 CLIENT: QUANTERRA, INC.
 JAR SAMPLES RECEIVED ON
 8-13-99

Figure No. 24

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	15.3	69.2	15.5	

[illegible]

MATERIAL DESCRIPTION	USCS	AASHTO
• BLACK SILTY SAND WITH GRAVEL & BITUMINOUS MAT'L		

Project No.:
Project: SR017646
● Location: A9H120186-035 D197Q-1-01

Date: 8/27/99

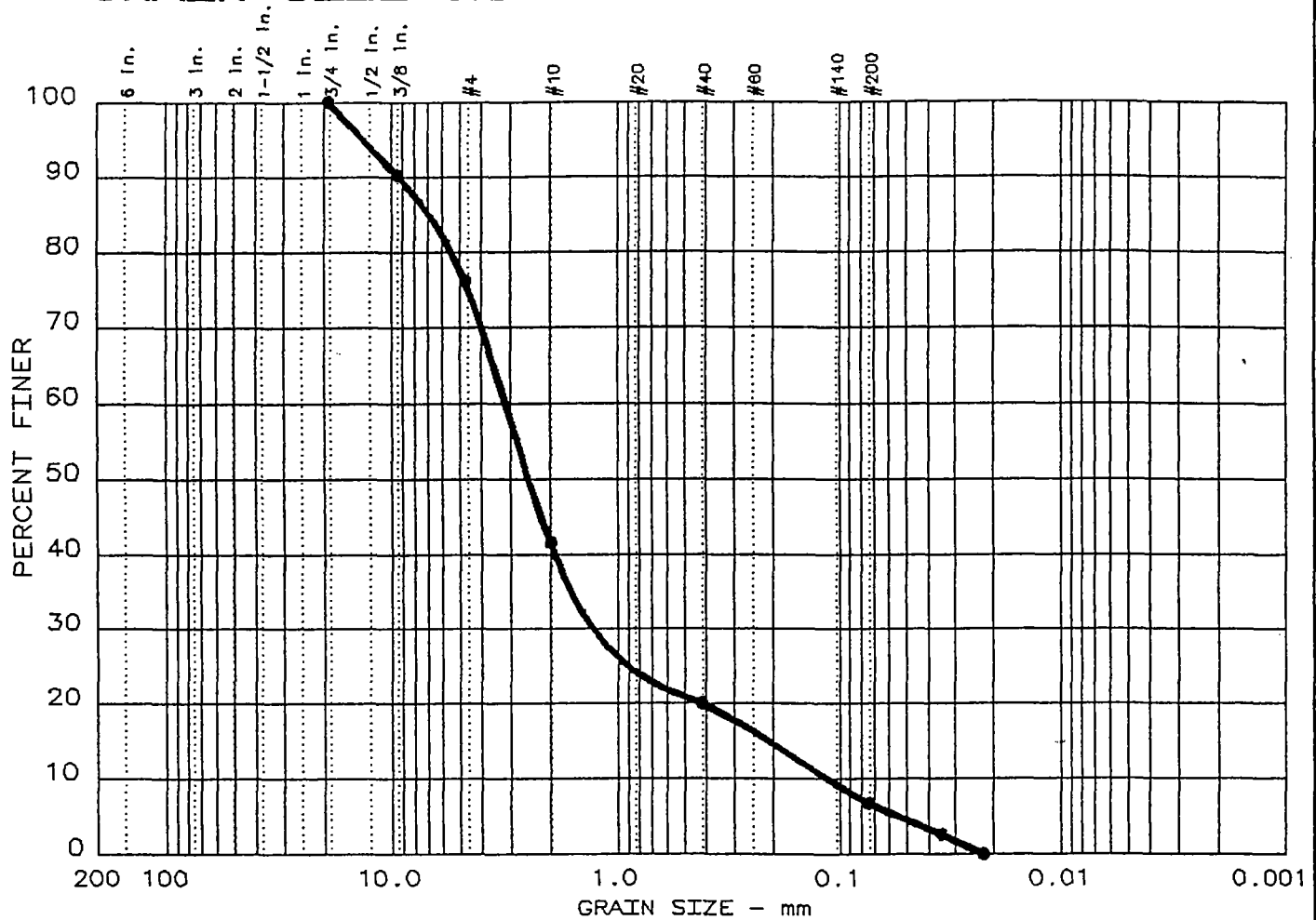
GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:
CLIENT: QUANTERRA, INC.
JAR SAMPLES RECEIVED ON
8-13-99
19.2% BITUMINOUS MAT'L

Figure No. 25

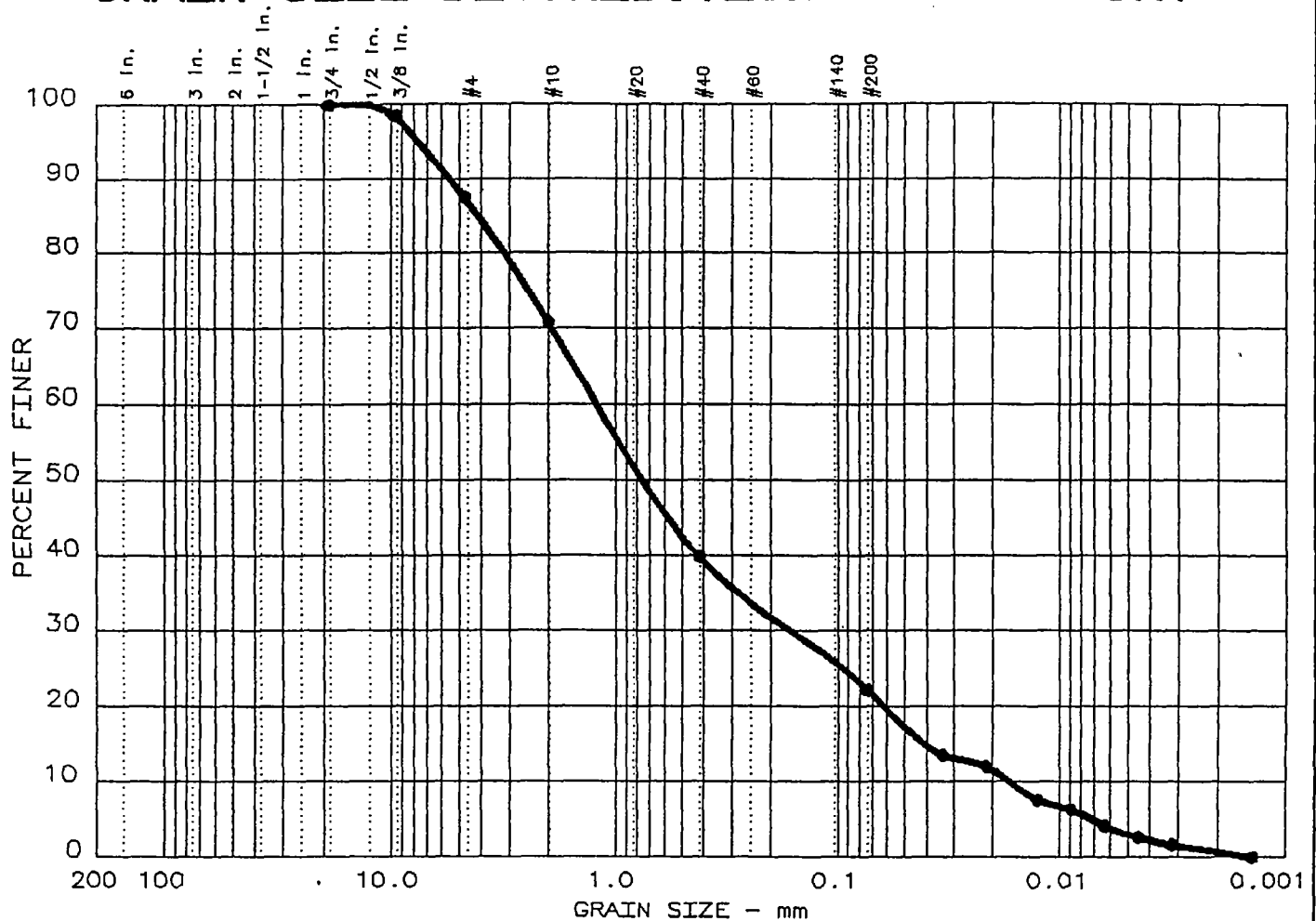
5-6

GRAIN SIZE DISTRIBUTION TEST REPORT



E. 9.5

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	12.6	65.2	19.2	3.0

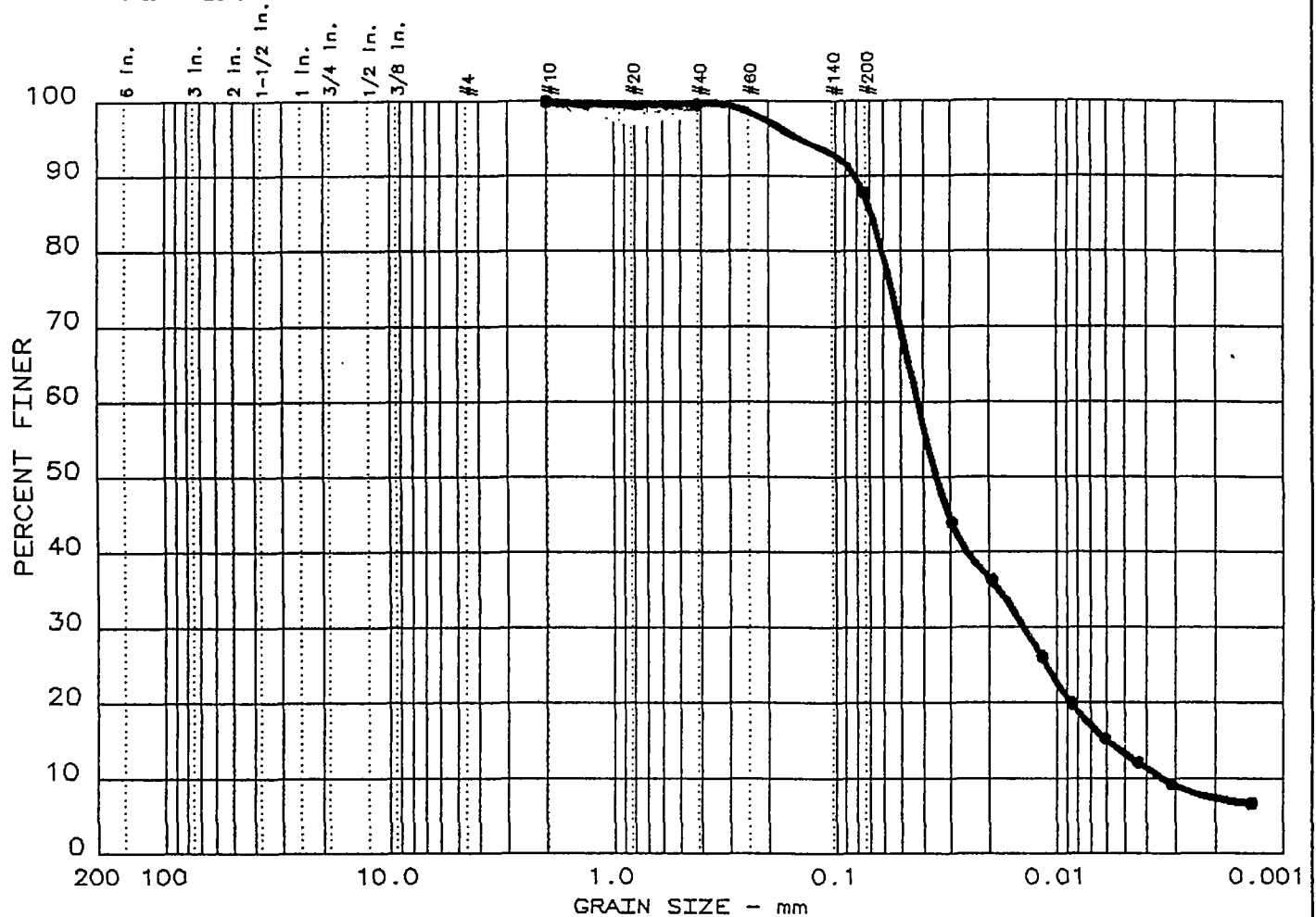
LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		4.12	1.22	0.75	0.164	0.0412	0.0168	1.32	72.4

MATERIAL DESCRIPTION	USCS	AASHTO
● LIGHT GRAY CRUSHED CHALKY MATERIAL		

Project No.: Project: SR017646 ● Location: A9H120186-037 D197T-1-01 Date: 8/26/99	Remarks: CLIENT: QUANTERRA, INC. JAR SAMPLES RECEIVED ON 8-13-99
GRAIN SIZE DISTRIBUTION TEST REPORT APPLIED CONSTRUCTION TECH., INC.	
Figure No. 27	

10-12

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	12.3	74.5	13.2

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
				0.03	0.014	0.0060	0.0034	1.38	12.3

MATERIAL DESCRIPTION	USCS	AASHTO
● DARK GRAY SILTY CLAY, LITTLE SAND, TRACE ORGANICS	CL-ML	

Project No.:
 Project: SR017646
 ● Location: A9H120186-038 D197W-1-01

Date: 8/27/99

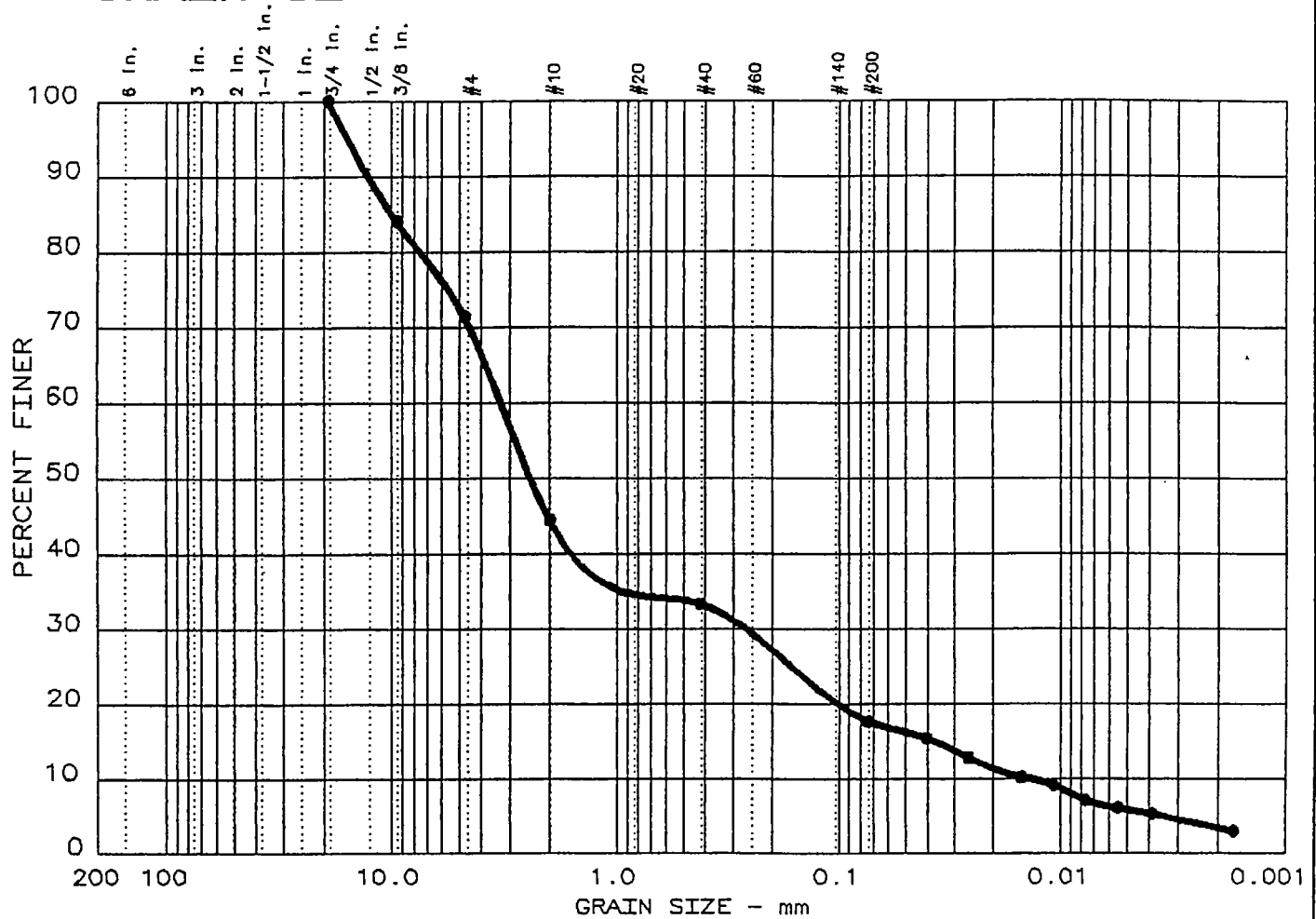
GRAIN SIZE DISTRIBUTION TEST REPORT
APPLIED CONSTRUCTION TECH., INC.

Remarks:
 CLIENT: QUANTERRA, INC.
 JAR SAMPLES RECEIVED ON
 8-13-99

Figure No. 28

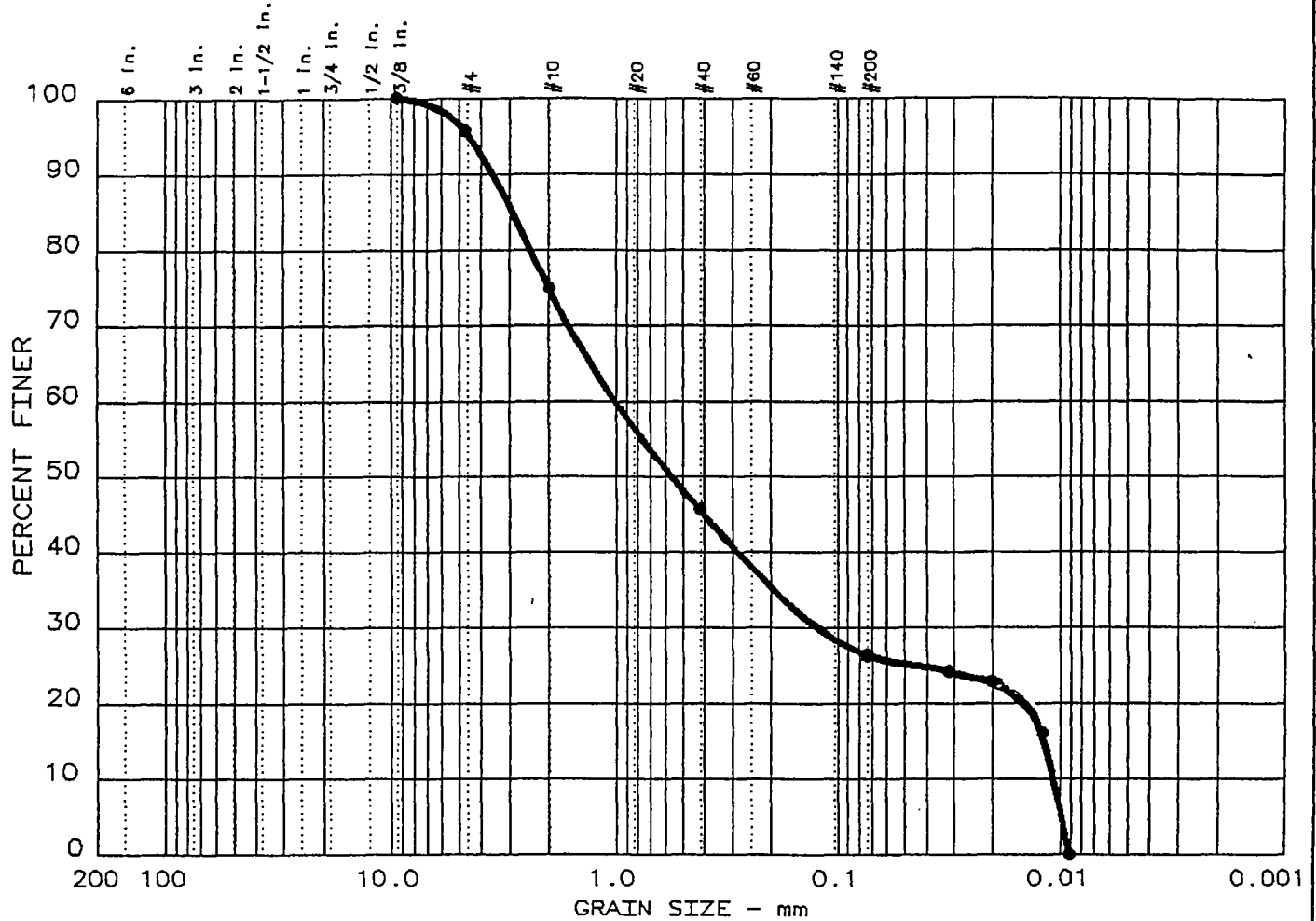
11 (0.5 - 1.2)

GRAIN SIZE DISTRIBUTION TEST REPORT

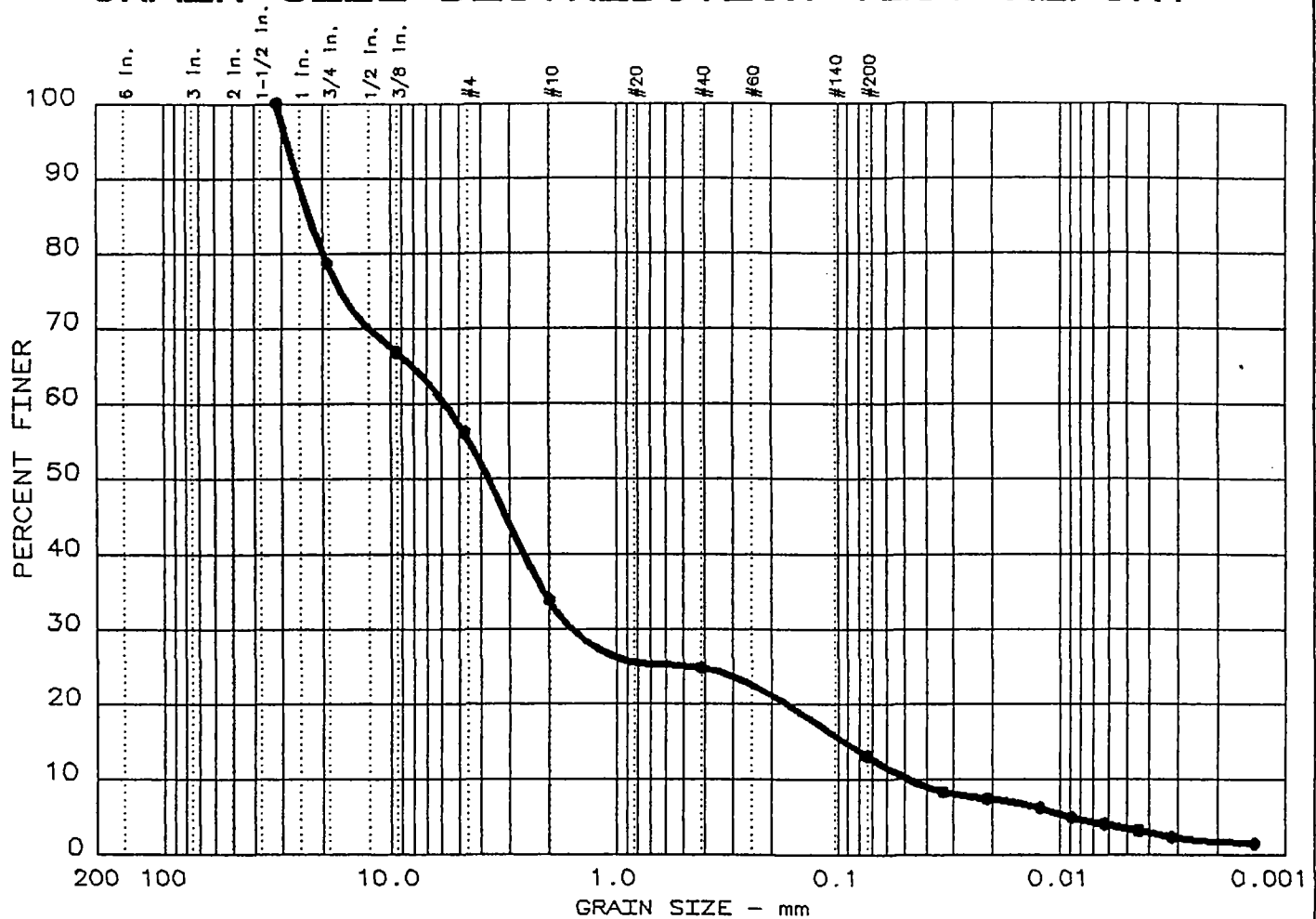


2-4)

GRAIN SIZE DISTRIBUTION TEST REPORT



GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	43.8	43.1	9.6	3.5

[illegible]

MATERIAL DESCRIPTION	USCS	AASHTO
● BLACK COAL AND CINDERS		

Project No.:

Project: SR017646

● Location: A9H120186-041 D1984-1-01

Date: 8/27/99

GRAIN SIZE DISTRIBUTION TEST REPORT

APPLIED CONSTRUCTION TECH., INC.

Remarks:

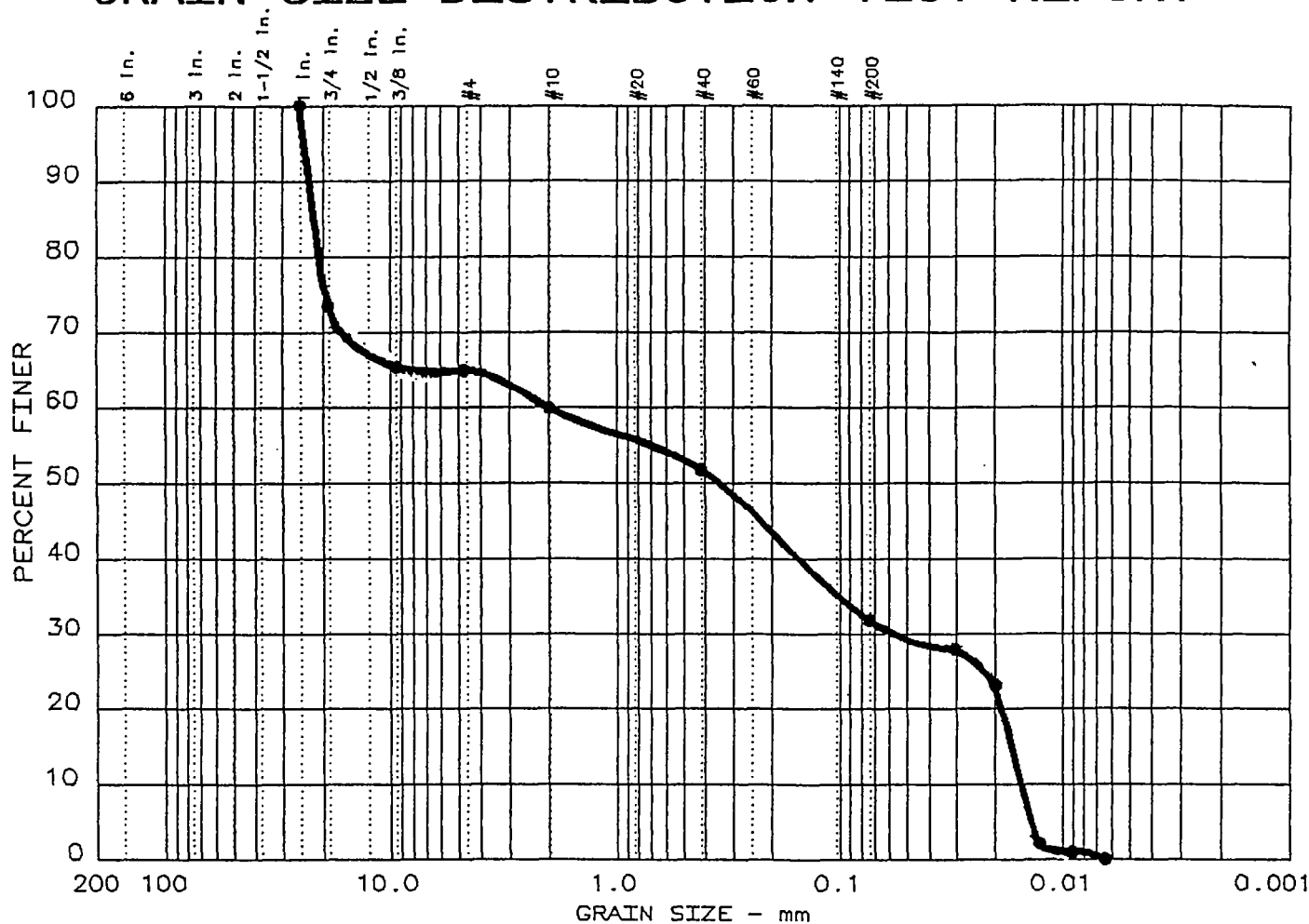
CLIENT: QUANTERRA, INC.

JAR SAMPLES RECEIVED ON

8-13-99

Figure No. 31

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	35.1	33.0	31.9	

[illegible]

MATERIAL DESCRIPTION	USCS	AASHTO
● LIGHT GRAY CRUSHED CHALKY MATERIAL		

Project No.:
Project: SR017646
● Location: A9H120186-042 D1985-1-01

Date: 8/27/99

GRAIN SIZE DISTRIBUTION TEST REPORT

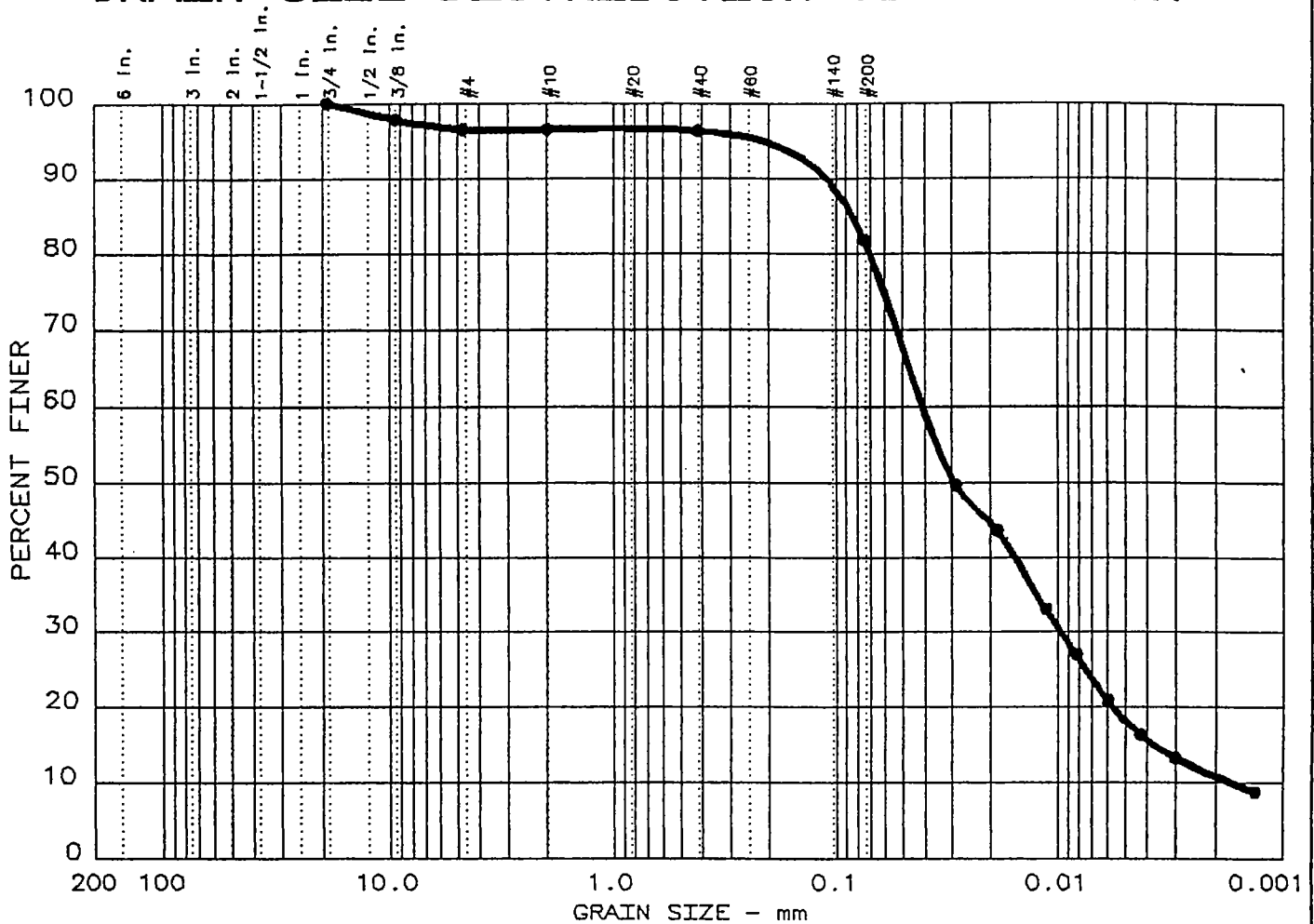
APPLIED CONSTRUCTION TECH., INC.

Remarks:
CLIENT: QUANTERRA, INC.
JAR SAMPLES RECEIVED ON
8-13-99

Figure No. 32

16-12

GRAIN SIZE DISTRIBUTION TEST REPORT



% +3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	3.5	14.8	63.6	18.1

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		0.08		0.03	0.010	0.0037	0.0017	1.38	24.0

MATERIAL DESCRIPTION	USCS	AASHTO
● BLACK CLAY WITH ORGANICS, LITTLE SAND, TR GRAVEL		

Project No.:

Project: SR017646

● Location: A9H120186-043 D1986-1-01

Date: 8/27/99

Remarks:

CLIENT: QUANTERRA, INC.

JAR SAMPLES RECEIVED ON

8-13-99

GRAIN SIZE DISTRIBUTION TEST REPORT

APPLIED CONSTRUCTION TECH., INC.

Figure No. 33

Quanterra Incorporated
SAMPLE ANALYSIS REQUISITION

LABORATORY: Applied Construction Technologies, Inc. NEED ANALYTICAL REPORT BY
210 Hayes ~~8/25/99~~ 8.30.99
Suite C
Cleveland OH 44132, GIR AR

ATTN:

call Allesia Danford w/70.

LAB PURCHASE ORDER: SR017646

(330) 966-9783

CLIENT CODE: 2508 PROJECT MANAGER: Allesia M. Danford

NUMBER OF SAMPLES IN LOT: 0000 43

<u>SAMPLE I.D.</u>	<u>SAMPLING DATE</u>	<u>ANALYSIS REQUIRED</u>
A9H120186-001 D193T-1-01	8/04/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-002 D1944-1-01	8/04/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-003 D1945-1-01	8/04/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-004 D1948-1-01	8/04/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-005 D194A-1-01	8/04/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-006 D194E-1-01	8/04/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-007 D194G-1-01	8/04/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-008 D194L-1-01	8/04/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-009 D194R-1-01	8/05/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-010 D194X-1-01	8/05/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63

* CONTINUED *

Quanterra Incorporated
SAMPLE ANALYSIS REQUISITION

LABORATORY: Applied Construction Technologies, Inc. NEED ANALYTICAL REPORT BY
210 Hayes 8/25/99
Suite C ROUTINE
Cleveland OH 44131, GIR AR

ATTN:

LAB PURCHASE ORDER: 9R017646

CLIENT CODE: 2508 PROJECT MANAGER: Alesia M. Danford

NUMBER OF SAMPLES IN LOT: 0000

<u>SAMPLE I.D.</u>	<u>SAMPLING DATE</u>	<u>ANALYSIS REQUIRED</u>
A9H120186-011 D1952-1-01	8/05/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-012 D1953-1-01	8/05/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-013 D195A-1-01	8/05/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-014 D195D-1-01	8/05/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-015 D195G-1-01	8/05/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-016 D195L-1-01	8/05/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-017 D195R-1-01	8/05/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-018 D195T-1-01	8/05/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-019 D195X-1-01	8/05/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-020 D1962-1-01	8/05/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63

* CONTINUED *

Quanterra Incorporated
SAMPLE ANALYSIS REQUISITION

LABORATORY: Applied Construction Technologies, Inc. NEED ANALYTICAL REPORT BY
210 Hayes 8/25/99
Suite C ROUTINE
Cleveland OH 44131, GIR AR

ATTN:

LAB PURCHASE ORDER: SR017646

CLIENT CODE: 2508 PROJECT MANAGER: Alesia M. Danford

NUMBER OF SAMPLES IN LOT: 0000

<u>SAMPLE I.D.</u>	<u>SAMPLING DATE</u>	<u>ANALYSIS REQUIRED</u>
A9H120186-021 D1969-1-01	8/05/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-022 D196E-1-01	8/09/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-023 D196H-1-01	8/09/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-024 D196K-1-01	8/09/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-025 D196M-1-01	8/09/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-026 D196P-1-01	8/09/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-027 D196W-1-01	8/09/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-028 D1971-1-01	8/10/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-029 D1975-1-01	8/10/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-030 D1978-1-01	8/10/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63

* CONTINUED *

(Quanterra Incorporated
SAMPLE ANALYSIS REQUISITION

LABORATORY: Applied Construction Technologies, Inc. NEED ANALYTICAL REPORT BY
210 Hayes 8/25/99
Suite C ROUTINE
Cleveland OH 44131, GIR AR

ATTN:

LAB PURCHASE ORDER: SR017646

CLIENT CODE: 2508 PROJECT MANAGER: Alesia M. Danford

NUMBER OF SAMPLES IN LOT: 0000

<u>SAMPLE I.D.</u>	<u>SAMPLING DATE</u>	<u>ANALYSIS REQUIRED</u>
A9H120186-031 D197D-1-01	8/10/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-032 D197G-1-01	8/10/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-033 D197L-1-01	8/10/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-034 D197P-1-01	8/11/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-035 D197Q-1-01	8/11/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-036 D197R-1-01	8/11/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-037 D197T-1-01	8/11/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-038 D197W-1-01	8/11/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-039 D197X-1-01	8/11/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-040 D1980-1-01	8/11/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63

* CONTINUED *

Quanterra Incorporated
SAMPLE ANALYSIS REQUISITION

LABORATORY: Applied Construction Technologies, Inc. NEED ANALYTICAL REPORT BY
210 Hayes 8/25/99
Suite C ROUTINE
Cleveland OH 44131, GIR AR

ATTN:

LAB PURCHASE ORDER: SR017646

CLIENT CODE: 2508 PROJECT MANAGER: Alesia M. Danford

NUMBER OF SAMPLES IN LOT: 0000

<u>SAMPLE I.D.</u>	<u>SAMPLING DATE</u>	<u>ANALYSIS REQUIRED</u>
A9H120186-041 D1984-1-01	8/11/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-042 D1985-1-01	8/11/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63
A9H120186-043 D1986-1-01	8/11/99	Grain Size Analysis (D422-63) (GR.SIZE) METHOD: D 422-63

NEED DETECTION LIMIT AND ANALYSIS DATE INCLUDED IN REPORT.

SHIPPING METHOD: COURIER

DATE: 8/12/99

SEND REPORT TO: ALESIA DANFORD

SAMPLE RECEIVED BY: LeeDATE: 8/13/99

PLEASE SEND A SIGNED COPY OF THIS FORM WITH REPORT AT COMPLETION OF ANALYSIS.

THANK YOU.

Quanterra - North Canton

INT: _____

8/12/99 14:21:56

Applied Construction Technologies, Inc.
210 Hayes
Suite CRELINQUISHED BY: quanterraDATE/TIME: 9/08/99 5:00P

RELINQUISHED BY: _____

DATE/TIME: _____

RECEIVED FOR LAB BY: _____

DATE/TIME: _____

PLEASE RETURN ORIGINAL SAMPLE ANALYSIS REQUISITION

Voice 630/990-7200, Fax 630/990-7218

COC No. 001300

DISTRIBUTION: Pink Sampling Coordinator - White and Yellow Accompany Shipment - White Returned with Report

PARSONS ENGINEERING SCIENCE, INC.

1000 Jorie Boulevard, Suite 200, Oak Brook, Illinois 60523-2233
Voice 630/990-7200, Fax 630/990-7218

2 4

Chain-of-Custody Record

COC No. 001301

PROJECT NUMBER 733893		PROJECT NAME/LOCATION BAF Wyandotte				PRESERVATIVES (All samples cooled to 4°C) <i>None</i>										
PROJECT MANAGER: <i>Mona Sutherland</i>						ANALYSES REQUESTED										
SAMPLER(S) NAME: (Please Print) <i>Mark Pentyle</i> <i>[Signature]</i> (Signature)						<div style="display: flex; align-items: center; justify-content: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); border: 1px solid black; padding: 5px;">Glass Size (ASPM)</div> <div style="border: 1px solid black; width: 100px; height: 100px; background: repeating-linear-gradient(45deg, transparent, transparent 2px, black 2px, black 4px);"></div> </div>										
Date MM/DD/YY	Military Time	Comp	Grab	Sample Identification	Matrix											Container
8/5/99	1120			CMSMW-4-13.5'-15.5'	S	4oz	<div style="display: flex; align-items: center; justify-content: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); border: 1px solid black; padding: 5px;">Glass Size (ASPM)</div> <div style="border: 1px solid black; width: 100px; height: 100px; background: repeating-linear-gradient(45deg, transparent, transparent 2px, black 2px, black 4px);"></div> </div>									
	1620			CMSMW-5-1'-3'	S	4oz										
				CMSMW-5-3'-5'	S	4oz										
				CMSMW-5-4'-6'	S	4oz										
				CMSMW-5-6'-8'	S	4oz										
				CMSMW-5-7'-8'	S	4oz										
				CMSMW-5-15'-15.5'	S	4oz										
				CMSMW-5-15.5'-16'	S	4oz										
8/9/99	1215			CMSMW-6-2'-4'	S	4oz										
				CMSMW-6-5'-6'	S	4oz										
				CMSMW-6-8'-10'	S	4oz										
				CMSMW-6-15'-16'	S	4oz										
				CMSMW-6-19'-19.2'	S	4oz										
				CMSMW-6-19.2'-20'	S	4oz										
Relinquished by: (Signature)		Date / Time		Received by: (Signature)		Date / Time										
Relinquished by: (Signature)		Date / Time		Received by: (Signature)		Date / Time										
Relinquished by: (Signature)		Date / Time		Received by: (Signature)		Date / Time										

DISTRIBUTION: Pink Sampling Coordinator - White and Yellow Accompany Shipment - White Returned with Report

PARSONS ENGINEERING SCIENCE, INC.

1000 Jorie Boulevard, Suite 250, Oak Brook, Illinois 60523-2233
Voice 630/990-7200, Fax 630/990-7218

3 4

Chain-of-Custody Record

COC No. 001303

PROJECT NUMBER 733893		PROJECT NAME/LOCATION BASF Wyandotte				PRESERVATIVES (All samples cooled to 4°C) <i>None</i>																	
PROJECT MANAGER: Mona Sutherland						ANALYSES REQUESTED																	
SAMPLER(S) NAME: (Please Print) Mark Pawlyk <i>(Signature)</i>						<div style="display: flex; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); border: 1px solid black; padding: 5px;"> Grab Size (150mL) 2002 </div> <div style="flex-grow: 1; border: 1px solid black; background: repeating-linear-gradient(45deg, transparent, transparent 2px, black 2px, black 4px);"></div> </div>																	
Date MM/DD/YY	Military Time	Comp	Grab	Sample Identification	Matrix											Container	REMARKS						
8/10/99	1100			CMS MW - 7 - 1' - 2'	S	402																	
⊥	⊥			CMS MW - 7 - 10' - 12'	S	402																	
⊥	⊥			CMS MW - 7 - 12' - 14'	S	402																	
8/10/99	1510			CMS MW - 8 - 1' - 2'	S	402																	
⊥	⊥			CMS MW - 8 - 8' - 9.8'	S	402																	
⊥	⊥			CMS MW - 8 - 10' - 12'	S	402																	
8/11/99	1110			CMS MW - 10 - 3' - 5'	S	402																	
⊥	⊥			CMS MW - 10 - 7' - 8'	S	402																	
⊥	⊥			CMS MW - 10 - 5' - 6'	S	402																	
⊥	⊥			CMS MW - 10 - 8' - 9.5'	S	402																	
⊥	⊥			CMS MW - 10 - 10' - 12'	S	402																	
8/11/99	1415			CMS MW - 11 - 6" - 1.8'	S	402																	
⊥	⊥			CMS MW - 11 - 2' - 4'	S	402																	
⊥	⊥			CMS MW - 11 - 7.5' - 8'	S	402																	
Relinquished by: (Signature) <i>(Signature)</i>		Date / Time 8/11/99 1600		Received by: (Signature) <i>W. R. Baker</i>		Date / Time 8/12/99 955A											Airbill #: Cooler #: Laboratory: Quanterra Attn.: Sample Receiving Send Report to: Mona Sutherland TAT Expected: Per contract						
Relinquished by: (Signature)		Date / Time		Received by: (Signature)		Date / Time																	
Relinquished by: (Signature)		Date / Time		Received by: (Signature)		Date / Time																	

DISTRIBUTION: Pink Sampling Coordinator - White and Yellow Accompany Shipment - White Returned with Report

Voice 630/990-7200, Fax 630/990-7218

COC No. 001302

DISTRIBUTION: Pink Sampling Coordinator - White and Yellow Accompany Shipment - White Returned with Report

Quanterra® Cooler Receipt Form/Narrative

North Canton Facility

Client: PARSONS

Project: BASE Wyandotte

Quote#: _____

Cooler Received on: 8/12/99

Opened on: 8/12/99

by: _____

(Signature)

Fedx ☒ Client Drop Off ☐ UPS ☐ Airborne ☐

Other: _____

Cooler: ☒

Safe ☐

Foam Box ☐

Client Cooler ☐

Other: _____

Quanterra Shipper No#: 85

1. Were custody seals on the outside of the cooler and intact?

Yes ☒ No ☐

If YES, Quantity 2 Location 1 inch each side of cooler

Were the custody seals signed and dated?

Yes ☒ No ☐ NA ☐

2. Shipper's packing slip attached to this form?

Yes ☒ No ☐

3. Were custody papers included inside the cooler and relinquished?

Yes ☒ No ☐

4. Did you sign the custody papers in the appropriate place?

Yes ☒ No ☐

5. Packing material used:

Peanuts ☐ Bubble Wrap ☒ Vermiculite ☐ Foam ☐ None ☐ Other: _____

6. Cooler temperature upon receipt 20.5 °C (see back of form for multiple coolers/temp)

METHOD: Temperature Vial ☐ Coolant ☐ Against Bottles ☒

COOLANT: Wet Ice ☐ Blue Ice ☐ Dry Ice ☐ None ☒

7. Were all the bottles sealed in separate plastic bags?

Yes ☒ No ☐

8. Did all bottles arrive in good condition (Unbroken)?

Yes ☒ No ☐

9. Did all bottle labels and tags agree with the custody papers?

Yes ☒ No ☐

10. Were samples at the correct pH?

Yes ☐ No ☐ NA ☒

11. Were correct bottles used for the tests indicated?

Yes ☒ No ☐

12. Were air bubbles >6 mm in any VOA vials?

Yes ☐ No ☐ NA ☒

13. Was a sufficient amount of sample sent in each bottle?

Yes ☒ No ☐

Contacted PM AMN Date: 8/12/99 by: WRC

via Voice Mail ☒ Verbal ☐ Other ☐

Concerning: cooler temp

Check ☒ MACRO ☐ MACRO

1. CHAIN OF CUSTODY

SR1A	Samples were received under proper custody procedures and without discrepancies.
SR1B	The chain of custody and sample bottles did not agree. The following discrepancies occurred _____

2. SAMPLE CONDITION

SR2A	Sample(s) _____ were received or requested after the recommended holding time had expired.
SR2B	Sample(s) _____ were received with insufficient volume
SR2C	Sample(s) _____ were received in a broken container.

3. SAMPLE PRESERVATION

v	SR3A	The temperature of the cooler was _____ °C
	SR3C	Sample(s) _____ were received incorrectly preserved and were adjusted accordingly in sample receiving.
	SR3D	Sample(s) _____ were received incorrectly preserved and split off in sample receiving.
	SR3E	Samples (s) _____ were received incorrectly preserved and were unable to be analyzed.
	SR3F	Sample(s) _____ were received with bubble > 6 mm in diameter (cc: PM)
	N/A	See back for other anomalies

LEVEL III REVIEW - PROJECT MANAGEMENT CHECKLIST

Rev 03

Client Name Parsons Engineering Science
 Client Code 2508
 Lot# A94120186
ALUS21
 At Due Date 9-9
 Paginate # of Copies 1
 Additional Reports to:

~~Invoice with Report~~
~~Invoice Separate~~
 Other

Hold Invoice

Diskette Needed ~~Yes~~
 Original C-O-C with Report
 Unbound

No BB
 Yes No
 Spiral Staped

- | | |
|---|-------------------------------------|
| 1. Cover | E. All dates correct |
| A. Sample IDs on cover | F. QC batch number correct |
| 2. Project Narrative | G. TIC pages included |
| 3. Discrepancies communicated to client | H. Results need dry weight basis |
| 4. Executive Summary | I. Samples analyzed w/holding time |
| 5. Method Summary | J. HTV form in project file |
| 6. Sample Summary | 8. Quality Control Report |
| 7. Analytical Report | A. Checklists from each group |
| A. Report in order | B. Client requested MS/MSD |
| B. Units match | C. CA form in project file |
| C. Detection limits correspond | D. QC narrative addresses anomalies |
| D. Surrogates w/acceptable limits | 9. Field Report included |

Comments:

Reviewed by: IND 9-1

PM has reviewed this report for the above criteria

Ans 9/2/99

KRI INFORMATION

Was report mailed on time? YES or NO
 If no, why?

Was fax required? YES or NO
 If no, why?

Was it faxed on time? YES or NO

Was report re-issued? YES
 Why?

Amount Invoiced

\$2295

Account Manager

% Account Manager